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# GROWTH OF CHILDREN IN HEIGHT AND WEIGHT.*

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For the past few years the province of psychology has been rapidly extending. While tradition has sought by means of definitions and classifications, epistemological or ontological, to maintain sharply defined limits, nevertheless practical thought and investigation have done and are doing much to break down these formal barriers, as we realize when we turn from our Sir William Hamilton to Wundt, from Bain to Lloyd Morgan, from McCosh to James. This does not necessarily mean that the past is wrong, but it at least signifies

*A bibliography will be found at the conclusion, numbered and in alphabetical order. The names of all contributors mentioned in the text will be found in this bibliography. In cases where one individual has contributed more than one article, or confusion for any other reason may be possible, the bibliography number will be found in the text as a means of readier reference. For page references a dagger (†) will indicate that the page number will be found as a footnote.

This article constitutes the preliminary first part to a general review of the studies which have been made upon the physical and mental development of children during the years usually spent in the common schools, more particularly the primary school. It aims (1) to present the salient facts from these studies rather than to draw general conclusions; and (2) to serve those who have occasion to investigate these fields as a pathfinder to sources of information. Dealing with the child only to the end of his common school period, this review touches upon the phenomena of adolescence only incidentally. President G. Stanley Hall's book upon adolescence, shortly forthcoming, will review exhaustively not only the adolescent field, but also will treat in a larger philosophic way the general principles of growth and development.—F. B.

that psychology is growing, that the present is bigger than the past, that there is in modern investigation a spirit seeking organic relations which the formalism of old conceptions is powerless to withstand. Any systematic study of genetic psychology at the present juncture begins with the phenomena of physical growth. Not that up to this time a code of definite principles of growth has been formulated, but the dominant tendency of modern mental science has been to correlate more closely the mental and physical. Definite and final conclusions showing the exact and specific relations of this element to that are hardly matured, but a large number of investigations have been made, and for proper orientation towards educational problems of the present, the educator must have acquaintance with the trend of these investigations. Some bold attempts have been made to strike out direct relations between mental capacity and forms of physical growth, as, for example, Dr. Porter, from an examination of St. Louis children, concludes that the taller and heavier children at a given age are, on the average, mentally brighter. While perhaps we may be yet far from definite conclusions upon any of these problems, it is clear that the numerous studies suggesting the dependence of mental development, through physical development, upon age, nutrition, race, sex, climate, height, weight, etc., necessarily form the logical starting point of a pedagogical study of children.

We shall commence, therefore, with a review of the studies upon growth in height and weight, and later consider various other elements which have been put forth as conditioning factors of mental development. We have little data for growth from birth to six years,* for the reason, of course, that children in masses are not accessible until they go to school. We know very little of growth after the seventeenth or eighteenth year, for the same reason. Within the school ages, interest has centred largely upon pubertal growth, and the years from six to eleven or twelve have been somewhat neglected. Several attempts have been made to classify growth into periods. There is universal agreement that three periods are distinctly discernible — a period from birth to puberty, a period during the progress of pubertal changes, and a period after these changes; but attempts to break up these periods into smaller ones as yet lack general assent upon any exact basis of serviceable classification.

Vierordt ([35]) divides growth into seven periods, as follows: first, suckling period, from birth to first teething in seventh or

* The most complete treatments of this period will be found by Camerer ([22, 23]), Daffner ([27, 28]), and Vierordt ([32, 34, 35]).

([35]) P. 601.

eighth month, in which the breathing, digestion and senses begin their specific activities; second, later child age to the second dentition, in seventh or eighth year; third, to puberty in fourteenth or fifteenth year; fourth, to complete development in height in twenty-first or twenty-second year; fifth, early adult age; sixth, later adult age to sixtieth year; seventh, old age. Liharzik somewhat arbitrarily divided the first twenty-five years of life into twenty-four periods. Zeissing ([94]) found three: first, one of decrease in the yearly increments of growth up to nine years; second, increase of yearly increments to the seventeenth year; and third, a later decrease. Hartwell ([50]) follows this division upon the physiological grounds that during the first period the brain practically completes its growth, and the child is sensory rather than motor. Axel Key ([59]) finds, first, a period 6 to 8 years of moderate annual increase; second, a period 9 to 13 years of least increase; third, a period 13 to 17 of greatest increase, and a period 17 to 19 of decreasing rate of increment. Combe makes two periods during school age: 7 to 10 and 14 to 17 in boys, and 7 to 12 and 12 to 15 in girls. Lange finds four periods: first, birth to 2 years, highest rate of growth; second, 2 to 12 years, decreasing annual increments; third, 12 to 15 years, mental growth; fourth, 15 to 21 years, a sudden decrease in annual increments.

The question of the point at which growth matures is one which has reached, as yet, no definite conclusion. Certainly there is no disagreement upon the fact that under normal conditions, no material increments of importance occur after the nineteenth year, though unquestionably there is increase of theoretical value up to the twenty-first or twenty-second year, if not until very much later. Growth in height certainly matures before growth in weight.

Quetelet (†[80]) put maturity at the 30th year in men, and 25th year in women. Beyer ([9]) thinks we must add at least an inch to the average height for growth after the 19th year. Roberts' tables would indicate a maturity in weight at 22 for men, and at 19 for women. Baxter ([3]) found an increase in stature in men up to the 35th year, though he places the average age of maturity earlier. Villerme puts the age of maturity in males at 23, and Liharzik at 25. The Report of Committee of Anthropometry ([37]) places the maturity in height of women at 20 years, and of men at 23 years.

## STATURE.

The average length of new-born male infants has been generally taken as 50 centimeters (19.68 inches), and about one-half centimeter (approximately one-fifth of an inch) less for females (†[94]).

Other averages given by Vierordt ([94]) are as follows:

| | Males. | Females. |
|---|---|---|
| Russow, | 50 cm. | 49.5 cm. |
| Quetelet, | 50 | 49.4 |
| Kézmarsky, | 50.2 | 49.4 |
| Fesser, | 51.5 | 50.5 |
| Wagner, | 47.4 | 46.75 |
| Roberts, | 49.1 | 48.0 |

([80]) P. 170. ([94]) P. 2.

The Anthropometric Committee ([37]) from 451 males and 466 females in the hospitals of London and Edinburgh gives the average as 19.52 inches for boys and 19.32 for girls. Out of the 451 males, 133 measured 20 inches, 116 measured 19 inches, and the limits were from 15 to 24 inches. In the case of females, the limits were from 16 to 23 inches, and of the 466 cases, 131 were 19 inches, 117 were 20 inches, and 109 were 18 inches.

Vierordt, quoting Fasbender, finds that the average first-born children are about .43 cm. shorter than later born. On the other hand, Boas([14]) finds that first-born children distinctly exceed later-born children in stature as well as weight from the 6th year to the 15th in males, and until the adult state in females.

During the first year the child grows at the most rapid rate of its entire life. The average increase is probably between seven and eight inches. The rate of growth decreases rapidly from month to month of the first year, and in general it may be said that the rate decreases with age. However, as will be pointed out, there are important fluctuations which modify this rule. There are no data from large numbers of children available by which to determine the growth nor its rate up to five or six yesrs.

Russow finds that in the first month of life the infant grows 12½ per cent. of its height; the rate steadily decreases and in the twelfth month is 3 per cent. D'Espine and Picot (+[32]) give similar figures.

At one year of age, the child is on the average 70 to 75 cm. in length, showing an increase of about 50 per cent. for the first year. Russow ([34]) gives the length, at one year of age, as 73; Beneke, 70; Hahner, 75; Liharzik, 80 cm. ([34]) D'Espine and Picot give the lengths of each year as follows: first, 19.8 cm.; second, 9.0; third, 7.3; fourth, 6.4; fifth, 6; next ten years, 6 cm. Zeissing's lengths are as follows: 23.2, 10.6, 8.7, 7.5, 5.9, 6.6; Daffner ([27]), for boys, 21.9, 11.42, 6.56, 4.76, 6.34, 3.03,—for girls, 22.5, 12.11, 6.28, 6.49, 6.1, 4.3, 3.6.

The rate of growth in this early period, so far as data indicate, is practically the same for both sexes. Starting at birth slightly shorter than boys, the girls at six years of age are only a fraction of an inch shorter.

Roberts, 1.7 in.; Gilbert ([44]), .5 in.; Peckham, .3 in.; Oakland, .3 in. (girls taller); Danish ([51]), .0; Swedish ([68]), 1.2 in.; Geissler and Uhlitz, .3 in.; Porter, .5 in.; Geissler, .4 in.; Bowditch ([18]), .4 in.; Quetelet, .6 in.

Between 6 and 7 years of age, the average American child measures about 44 or 45 inches. This is an increase of 24 or 25 inches for the first six years of life, or about 43 per cent. of the length at birth. At 12 years of age American boys are on the average about 55 inches in height, an increase of 10 or 11 inches for the six preceding years; this amounts to an increase of about 20 per cent. or less of the height at 6 years—less than half the percentage rate for the first six years. Until

([32]) See, also, Reitz, "Grundzugie d. Therapie des Kindesalters," 1883, p. 22; Vierordt, "Daten u. Tabellen," p. 3.

10 to 12 years, there is no material difference between the heights of the sexes; but during these two years, varying with localities, the girls begin to grow faster than boys, and for the two or three years following are actually taller (Table A). During the 14th or 15th year, this rate materially slackens, and though girls grow slowly for two or three years longer, they have practically completed their growth in height, generally at the age of 15, as a glance at the tables of increases will show. The rate of accelerated growth in height, in the case of boys, begins during the period 12 to 14 as a rule. Boys are slower in reaching their maximum rate and therefore grow rapidly a longer time. They overtake the girls usually in the 15th year, and by the end of the 16th year or later, their period of accelerated rate ends. Until the 11th year or thereabouts, as stated, there is no material difference in the height of the two sexes. We have therefore to consider two distinct periods in the growth of an individual: first, the period before the rapid acceleration sets in until the 11th or 12th year in girls and the 13th or 14th in boys; secondly, the period after this accelerated rate sets in until maturity. The first period of growth includes that of the first five or seven years in school.

If now we glance at Table A of heights, taking, for example, the larger American studies of Bowditch, Peckham and Porter, we see that the rate of growth is somewhat rapid in the beginning, the 6th or 7th year, and decreases with fluctuations until about 10 years in girls and 12 years in boys, when the prepubertal acceleration sets in. This general decrease is to be observed in the case of all larger studies, though the year of the beginning of the prepubertal increase varies a year or so. The same decrease in rate from six years up to the time of the prepubertal increase is to be observed similarly in the case of girls. Curves constructed from absolute annual increases show, as a rule, in this childhood period one or two pronounced fluctuations, but they do not occur with a regularity in all charts sufficient to be of assurance that their cause is certainly physiological and not merely statistical. Nevertheless it will be observed that the curves are by no means regular. Growth seems to be by rapid increases followed by resting periods, by fits and starts as it were.

Gilbert ([44]) and Peckham have called attention to one such fluctuation, a decrease of rate in the 8th or 9th year, and suggest as a cause the second dentition.* Vierordt ([†35]) makes the second den-

* Camerer's curves ([37]) show very conclusively a halting of growth at the first dentition in infancy, and he unqualifiedly recognizes this cause.

([†35]) P. 601.

tition a physiological division line between two periods of childhood. Hartwell (1[50]) makes a physiological period end in 7th or 8th year, since the brain practically completes its growth at this period. This would seem to suggest a possible resting period for the bodily development.

On the whole, in the absence of any determinative data upon exact details, it is perhaps safer to regard the period from 6 years to the prepubertal increase as a general decrease in the rate of growth with one or two minor fluctuations. The investigations of Combe, Landsberger and Carstadt, made upon a comparatively small number of children, but more upon the plan of individual measurements, tracing the growth of individual children for a number of years, justifies this view.

If we subtract the average height at 6 years from the average height at 12 years for boys, we obtain from each of the three large American investigations approximately the same increase for the 6 years: Boston, 11.4 in.; St. Louis, 11.5 in.; Milwaukee, 10.9 in. The increases of girls, owing to earlier appearance of the prepubertal acceleration, can be taken only from 6 to 10 years. These increments are as follows: Boston, 8 in.; St. Louis, 8.2 in.; Milwaukee, 8.1 in.

Combe, who estimated the annual increases by grouping children of the same age in months, concludes: "The increase in boys to 14 and in girls to 11 is very regular, and varies only about a millimeter more or less. The twelve curves, which represent the monthly averages, constitute a narrow bundle of almost always parallel and seldom crossing lines."

Landsberger in Posen says: "The average yearly increase in height during the school age (6 to 13) can be taken in all zones as between 4.5 to 5.5 cm. with some safety—for the first half somewhat greater and for the last half somewhat smaller." Of course, he makes a mistake in applying this rule to girls, who in many localities are in 13th year already reaching their maximum of acceleration.

West (104) says: "If we compare the mean differences between the general average and the averages for the six American cities (Boston, St. Louis, Milwaukee, Toronto, Worcester, Oakland) in weight and stature, we find that until about the 11th year the children develop with comparative uniformity, but from that age the modifying effects of descent and surroundings are beginning to act, causing the mean differences to increase very markedly."

TABLES AND CHARTS.—Table A gives the heights of children during the growing period. It is practically complete to date for the larger general investigations which have been made. In the originals of most of these the data have been given in centimeters, but these have been expressed in inches. In a study of them caution should be taken on a few matters. The extremes, those of the beginning or concluding ages in many cases, are based on a smaller number of measurements than the middle period. In some cases these doubtful averages have already been omitted. The figures of Dr. Porter for St. Louis are not comparable with the others, for the

(50) P. 57.

| AGE. | Boston. (Bowd'h.)[16] 13,691 Boys. 10,904 Girls. | | St. Louis. (Porter.)[78] 16,295 Boys. 18,059 Girls. Age nearest Birthday. | | Milwaukee. (Peck'm.)[75] 4,773 Boys. 4,891 Girls. | | Oakland.[75] Number not Stated. | | Worcester. (West.)[47] 3,250 Children. | | New (Gil Abo each eac |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| 0 | | | | | | | | | | | |
| 1½ | | | | | | | | | | | |
| 2½ | | | | | | | | | | | |
| 3½ | | | | | | | | | | | |
| 4½ | | | | | 39.98 | 39.65 | | | | | |
| 5½ | 41.57 | 41 29 | | | 42.28 | 41.72 | | | 43.2 | 42.3 | |
| 6½ | 43.75 | 43.35 | 42.9 | 42.4 | 44.08 | 43.78 | 44.1 | 44.4 | 44.4 | 43.8 | 45.0 |
| 7½ | 45.74 | 45.52 | 44.9 | 44.5 | 46.09 | 45.93 | 45.0 | 44.9 | 46.1 | 46.3 | 47.1 |
| 8½ | 47.76 | 47.58 | 46.9 | 46.6 | 48.05 | 47.59 | 47.6 | 46.8 | 48.2 | 47.9 | 48.9 |
| 9½ | 49.69 | 49.37 | 49.0 | 48.7 | 50.00 | 49.81 | 49.3 | 49.2 | 50.0 | 49.8 | 51.2 |
| 10½ | 5'.68 | 51.34 | 50.7 | 50.6 | 51.85 | 51.89 | 51.9 | 51.5 | 52.8 | 52.3 | 53.0 |
| 11½ | 53.33 | 53.42 | 52.7 | 52.4 | 53.76 | 53.8 | 53.5 | 53.9 | 54.6 | 53.9 | 55.9 |
| 12½ | 55.1 | 55.9 | 54.4 | 54.8 | 55.0 | 56.5 | 55.1 | 56.6 | 56.3 | 57.0 | 57.0 |
| 13½ | 57.2 | 58.2 | 56.3 | 57.7 | 57.5 | 58.7 | 56.8 | 60.0 | 58.1 | 58.2 | 58.8 |
| 14½ | 59.9 | 59.9 | 58.3 | 59.3 | 59.9 | 60.5 | 59.7 | 61.2 | 60.7 | 60.5 | 59.3 |
| 15½ | 62.3 | 61.1 | 61.0 | 61.0 | 62.3 | 61.6 | 61.8 | 61.9 | 63.9 | 61.8 | 62.8 |
| 16½ | 65.0 | 61.6 | 63.1 | 62.0 | 65.1 | 62.2 | 64.5 | 62.7 | 65.3 | 62.4 | 65.7 |
| 17½ | 66.2 | 61.9 | 65.0 | 62.7 | 66.6 | 62.9 | 67.1 | 62.7 | 66.3 | 62.8 | 67.1 |
| 18½ | 66.7 | 61.9 | | 62.8 | | 62.5 | 67.6 | 63.2 | 66.9 | 62.6 | |
| 19½ | | | | 62.4 | | | | | 67.4 | 62.7 | |
| 20½ | | | | | | | | | 68.5 | 62.6 | |
| 21½ | | | | | | | | | 67.1 | 62.7 | |

TABLE A.

*Showing the Stature at Successive Ages in Var*

| New Haven (Gilbert.)[44] About 50 of each sex for each age. | | Iowa. (Gilbert.)[45] About 50 of each sex for each age. | | Pennsylv'a. (Hall.)[48] 2,434 Males (nude). | | Moscow. (Erism'n)[51] 3,212 Boys. 1,495 Girls. | | Sweden Com'ission. (Key.)[56] 15,000 Boys. 3,000 Girls. | | Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls. | | Englan (Robe'ts Over 10 Males | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F |
| | | | | | | | | | | | | 41.2 | |
| 45.0 | 44.9 | 45.0 | 44.6 | | | | | 45.6 | 44.5 | 44.1 | 44.1 | 43.2 | |
| 47.1 | 46.9 | 47.8 | 46.8 | | | 44.1 | 43.9 | 47.6 | 45.7 | 45.3 | 45.3 | 45.0 | |
| 48.9 | 48.4 | 49.6 | 49.2 | | | 46.4 | 45.8 | 49.6 | 48.4 | 47.2 | 47.2 | 47.0 | |
| 51.2 | 50.8 | 51.3 | 51.3 | 51.2 | | 48.3 | 47.1 | 51.6 | 50.0 | 49.2 | 49.2 | 49.2 | |
| 53.0 | 52.8 | 53.3 | 53.0 | 53.9 | | 51.5 | 49.2 | 52.4 | 52.0 | 51.2 | 51.2 | 50.5 | |
| 55.9 | 54.6 | 55.2 | 54.5 | 55.1 | | 53.4 | 51.1 | 53.5 | 53.9 | 53.1 | 52.4 | 51.5 | |
| 57.0 | 57.9 | 57.1 | 58.0 | 56.7 | | 55.2 | 52.3 | 55.1 | 56.3 | 54.3 | 54.3 | 53.0 | |
| 58.8 | 60.4 | 58.7 | 59.2 | 61.0 | | 57.2 | 54.5 | 56.7 | 58.3 | 56.3 | 57.5 | 55.9 | |
| 59.3 | 61.4 | 61.7 | 61.7 | 62.3 | | 59.1 | 57.4 | 58.7 | 60.2 | 58.7 | 59.4 | 57.8 | |
| 62.8 | 62.5 | 64.7 | 63.3 | 65.3 | | 61.6 | | 61.4 | 61.8 | 61.4 | 60.6 | 60.7 | |
| 65.7 | 62.5 | 66.7 | 63.3 | 66.5 | | 63.5 | | 63.8 | 62.6 | 64.6 | 62.6 | 62.9 | |
| 67.1 | 63.6 | 68.2 | 64.5 | 67.1 | | 64.6 | | 65.7 | 63.0 | 65.7 | | 64.5 | |
| | | 68.6 | 64.6 | 67.3 | | | | 66.9 | 63.0 | 66.9 | | 65.5 | |
| | | 69.0 | 64.6 | 67.5 | | | | 67.3 | 63.8 | 66.9 | | 66.0 | |
| | | | | 67.6 | | | | 67.7 | 63.0 | | | 66.3 | |
| | | | | 67.7 | | | | | | | | | |

## TABLE A.

*ving the Stature at Successive Ages in Various Countries and Cities in inches.*

| 'a. | Moscow. (Erism'n)[31] 3,212 Boys. 1,495 Girls. | | Sweden Com'ission. (Key.)[58] 15,000 Boys. 3,000 Girls. | | Denmark Com'ission. (Hertel.)[21] 17,134 Boys. 11,250 Girls. | | England. (Robe'ts)[82] Over 10,000 Males. | | England. (Anthrop. Com.)[37] Over 30,000 Persons. | | Belgium. (Quete't.)[80] Selected Ten of each Age and Sex. | | Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls. | | Lusanne. (Combe.)[25] 6,662 Measurements of 2,000 Children. | | Freiburg. (Geissler-Uhlitsc'e)[43] 10,343 Boys. 10,830 Girls. | | (C 1, 1. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | |
| | | | | | | | | | | | 19.7 | 19.4 | | | | | | | |
| | | | | | | | | | | | 27.5 | 27.2 | | | | | | | |
| | | | | | | | | | | | 31.1 | 30.7 | | | | | | | |
| | | | | | | | | | 36.8 | 36.2 | 34.0 | 33.6 | 33.9 | 33.3 | | | | | |
| | | | | | | | | | 38.5 | 38.3 | 36.5 | 36.0 | 36.2 | 36.9 | | | | | |
| | | | | | | | 41.2 | | 41.0 | 40.6 | 38.9 | 38.3 | 38.2 | 38.0 | | | | | |
| | | | 45.6 | 44.5 | 44.1 | 44.1 | 43.2 | | 44.0 | 42.9 | 41.2 | 40.6 | 40.7 | 40.2 | | | 42.8 | 42.5 | 4 |
| | 44.1 | 43.9 | 47.6 | 45.7 | 45.3 | 45.3 | 45.0 | | 46.0 | 44.5 | 43.5 | 42.8 | 44.3 | 43.0 | 46.2 | 45.8 | 44.3 | 44.1 | 4 |
| | 46.4 | 45.8 | 49.6 | 48.4 | 47.2 | 47.2 | 47.0 | | 47.1 | 46.6 | 45.7 | 45.0 | 46.6 | 45.5 | 48.2 | 47.7 | 46.3 | 45.9 | 4 |
| | 48.3 | 47.1 | 51.6 | 50.0 | 49.2 | 49.2 | 49.2 | | 49.7 | 48.7 | 48.0 | 47.1 | 48.8 | 47.6 | 50.0 | 49.5 | 48.1 | 47.8 | 4 |
| | 51.5 | 49.2 | 52.4 | 52.0 | 51.2 | 51.2 | 50.5 | | 51.8 | 51.1 | 50.1 | 49.2 | 49.8 | 50.1 | 51.7 | 51.6 | 49.6 | 49.6 | 5 |
| | 53.4 | 51.1 | 53.5 | 53.9 | 53.1 | 52.4 | 51.5 | | 53.5 | 53.1 | 52.2 | 51.2 | 50.9 | 51.7 | 53.3 | 53.7 | 51.4 | 51.6 | 5 |
| | 55.2 | 52.3 | 55.1 | 56.3 | 54.3 | 54.3 | 53.0 | | 55.0 | 56.7 | 54.1 | 53.2 | 52.6 | 53.8 | 55.0 | 55.9 | 53.3 | 53.3 | 5 |
| | 57.2 | 54.5 | 56.7 | 58.3 | 56.3 | 57.5 | 55.9 | | 56.9 | 57.8 | 56.0 | 55.1 | 55.0 | 56.1 | 56.9 | 57.9 | 55.2 | 55.7 | 5 |
| | 59.1 | 57.4 | 58.7 | 60.2 | 58.7 | 59.4 | 57.8 | | 59.3 | 59.8 | 57.8 | 56.9 | 57.2 | 58.9 | | | | | |
| | 61.6 | | 61.4 | 61.8 | 61.4 | 60.6 | 60.7 | | 62.2 | 60.9 | 59.6 | 58.6 | 59.8 | 60.1 | | | | | |
| | 63.5 | | 63.8 | 62.6 | 64.6 | 62.6 | 62.9 | | 64.3 | 61.7 | 61.2 | 59.9 | 62.2 | 60.6 | | | | | |
| | 64.6 | | 65.7 | 63.0 | 65.7 | | 64.5 | | 66.2 | 62.5 | 62.8 | 60.9 | 63.0 | 61.0 | | | | | |
| | | | 66.9 | 63.0 | 66.9 | | 65.5 | | 67.0 | 62.4 | 64.2 | 61.5 | 63.3 | 61.0 | | | | | |
| | | | 67.3 | 63.8 | 66.9 | | 66.0 | | 67.3 | 62.8 | 65.2 | 61.8 | 63.7 | | | | | | |
| | | | 67.7 | 63.0 | | | 66.3 | | 67.5 | 63.0 | 65.7 | 62.0 | | | | | | | |
| | | | | | | | | | 67.6 | 63.0 | | | | | | | | | |

| rg. er- e)[42] oys. rls. | Gohlis. (Geissler)[43] 1,386 Boys. 1,420 Girls. | | Breslau. (Carsta't)[24] 4,274 Measurements of 600 Boys. | | Posen. (Landsberger.)[53] 37 to 104 Boys for Seven Yrs. | | Hamburg. (Kotelman.)[60] 515 Boys. | | Radom. (Sulikowski.)[58] 1,133 Boys. | | Saalfeld. (Schmidt)[55] 4,699 Boys. 4,807 Girls. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F. | M. | F. | M. | F. | M. | F | M. | F. | M. | F. | M. | F. |
| 2.5 | 43.4 | 43.0 | 43.0 | | 42.1 | | | | | | 43.0 | 42.7 |
| 4.1 | 45.0 | 44.8 | 44.8 | | 44.2 | | | | | | 45.0 | 44.9 |
| 5.9 | 47.0 | 46.3 | 46.8 | | 46.2 | | | | | | 47.2 | 46.6 |
| 7.8 | 48.8 | 48.8 | 48.7 | | 48.1 | | 50.6 | | 49.6 | | 49.2 | 48.8 |
| 9.6 | 50.8 | 50.6 | 50.6 | | 49.4 | | 51.5 | | 51.1 | | 50.5 | 50.9 |
| 1.6 | 52.1 | 52.7 | 52.5 | | 51.2 | | 53.2 | | 52.7 | | 52.3 | 52.6 |
| 3.3 | 54.4 | 54.9 | 54.4 | | 53.2 | | 55.1 | | 54.1 | | 54.3 | 54.6 |
| 5.7 | 55.4 | 57.1 | 56.4 | | 55.1 | | 56.3 | | 56.5 | | 56.0 | 56.8 |
| | | | 58.7 | | | | 58.6 | | 58.7 | | | |
| | | | 61.7 | | | | 60.7 | | 61.5 | | | |
| | | | 64.1 | | | | 63.7 | | 63.5 | | | |
| | | | | | | | 65.7 | | 65.2 | | | |
| | | | | | | | 66.3 | | 65.5 | | | |
| | | | | | | | 65.7 | | 65.3 | | | |
| | | | | | | | 65.8 | | 66.4 | | | |
| | | | | | | | | | 65.7 | | | |

*Showing the Absolute Annu*

| Age. | Boston. | | St. Louis.* | | Mil-wauk'e. | | Oak-land. | | Wor-cester. | | New Haven. | | Iowa. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | |
| 0½— 1½ | | | | | | | | | | | | | | | |
| 1½— 2½ | | | | | | | | | | | | | | | |
| 2½— 3½ | | | | | | | | | | | | | | | |
| 3½— 4½ | | | | | | | | | | | | | | | |
| 4½— 5½ | | | | | 2.3 | 2.1 | | | | | | | | | |
| 5½— 6½ | 2.2 | 2.1 | | | 1.8 | 2.1 | | | 1.2 | 1.5 | | | | | |
| 6½— 7½ | 2.0 | 2.2 | 2.0 | 2.1 | 2.6 | 2.2 | | | 1.7 | 2.5 | 2.1 | 2.0 | 2.8 | 2.2 | |
| 7½— 8½ | 2.0 | 2.1 | 2.0 | 2.1 | 1.4 | 1.7 | 2.6 | 1.9 | 2.1 | 1.6 | 1.8 | 1.5 | 1.8 | 2.4 | |
| 8½— 9½ | 1.9 | 1.8 | 2.0 | 2.1 | 2.0 | 2.2 | 1.7 | 2.4 | 1.8 | 1.9 | 2.3 | 2.4 | 1.7 | 2.1 | |
| 9½—10½ | 2.0 | 2.0 | 1.8 | 1.9 | 1.9 | 2.1 | 2.6 | 2.3 | 2.8 | 2.5 | 1.8 | 2.0 | 2.0 | 1.7 | 2 |
| 10½—11½ | 1.7 | 2.1 | 2.0 | 1.9 | 1.9 | 1.9 | 1.6 | 2.4 | 1.9 | 1.6 | 2.9 | 1.8 | 1.9 | 1.5 | 1 |
| 11½—12½ | 1.8 | 2.5 | 1.7 | 2.3 | 1.2 | 2.7 | 1.6 | 2.7 | 1.7 | 3.1 | 1.1 | 3.3 | 1.9 | 3.5 | 1 |
| 12½—13½ | 2.1 | 2.3 | 1.9 | 2.9 | 2.5 | 2.2 | 1.7 | 3.4 | 1.8 | 1.3 | 1.8 | 2.5 | 1.6 | 1.2 | 4 |
| 13½—14½ | 2.7 | 1.8 | 2.2 | 1.7 | 2.4 | 1.8 | 2.9 | 1.2 | 2.6 | 2.3 | 0.5 | 1.0 | 3.0 | 2.5 | 1 |
| 14½—15½ | 2.4 | 1.2 | 2.5 | 1.7 | 2.5 | 1.1 | 2.1 | 0.7 | 3.2 | 1.3 | 3.5 | 1.1 | 3.0 | 1.6 | 3 |
| 15½—16½ | 2.7 | 0.5 | 2.1 | 1.0 | 2.7 | 0.6 | 2.7 | 0.8 | 1.4 | 0.6 | 2.9 | 0.0 | 2.0 | 0.0 | 1 |
| 16½—17½ | 1.2 | 0.3 | 1.9 | 0.7 | 1.5 | 0.8 | 2.6 | 0.0 | 1.0 | 0.4 | 1.4 | 1.1 | 1.5 | 1.2 | 0 |
| 17½—18½ | | | 2.1 | | | | 0.5 | 0.5 | 0.6 | 0.1 | | | 0.4 | 0.1 | 0 |
| 18½—19½ | | | | | | | | | | | | | | | 0 |
| 19½—20½ | | | | | | | | | | | | | | | 0 |
| 20½—21½ | | | | | | | | | | | | | | | 0 |

*See explanation p. 259.

## TABLE B.

*Annual Increases in Height: Obtained by Subtracting the Successive Ages in*

| wa. | Penn. | | Moscow | | Sweden | | Den-mark. | | Eng-land. Robe'ts | | Engl'd. Anthro. Com. | | Belg'm. | | Turin. | | Lusan'e | | Freib'g. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| | | | | | | | | | | | | | 7.8 | 7.8 | | | | | | |
| | | | | | | | | | | | | | 3.6 | 3.5 | | | | | | |
| | | | | | | | | | | | | | 2.9 | 2.9 | | | | | | |
| | | | | | | | | | | | 1.7 | 2.1 | 2.5 | 2.4 | 2.3 | 2.7 | | | | |
| | | | | | | | | | | | 2.5 | 2.3 | 2.4 | 2.3 | 2.0 | 2.0 | | | | |
| | | | | | | | | | 2.0 | | 3.0 | 2.3 | 2.3 | 2.3 | 2.5 | 2.2 | | | | |
| 2.2 | | | | | 2.0 | 1.2 | 1.2 | 1.2 | 1.8 | | 2.0 | 1.6 | 2.3 | 2.2 | 3.6 | 2.8 | | | 1.5 | 1.6 |
| 2.4 | | | 2.3 | 1.9 | 2.0 | 2.7 | 1.9 | 1.9 | 2.0 | | 1.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.5 | 2.0 | 1.9 | 2.0 | 1.8 |
| 2.1 | | | 1.9 | 1.3 | 2.0 | 1.6 | 2.0 | 2.0 | 2.2 | | 2.6 | 2.1 | 2.3 | 2.1 | 2.2 | 2.1 | 1.8 | 1.9 | 1.8 | 1.9 |
| 1.7 | 2.8 | | 3.2 | 2.1 | 0.8 | 2.0 | 2.0 | 2.0 | 1.3 | | 2.1 | 2.4 | 2.1 | 2.1 | 1.0 | 2.5 | 1.7 | 2.0 | 1.5 | 1.8 |
| 1.5 | 1.2 | | 1.9 | 1.9 | 1.1 | 1.9 | 1.9 | 1.2 | 1.0 | | 1.7 | 2.0 | 2.1 | 2.0 | 1.1 | 1.6 | 1.6 | 2.1 | 1.8 | 2.0 |
| 3.5 | 1.5 | | 1.8 | 1.2 | 1.6 | 2.4 | 1.2 | 1.9 | 1.5 | | 1.5 | 3.6 | 1.9 | 2.0 | 1.7 | 2.1 | 1.7 | 2.2 | 1.9 | 1.7 |
| 1.2 | 4.3 | | 2.0 | 2.2 | 1.6 | 2.0 | 2.0 | 3.2 | 2.9 | | 1.9 | 1.1 | 1.8 | 1.9 | 2.4 | 2.3 | 1.9 | 2.0 | 1.7 | 2.4 |
| 2.5 | 1.3 | | 1.9 | | 2.0 | 1.9 | 2.4 | 1.9 | 1.9 | | 2.4 | 2.0 | 1.8 | 1.8 | 2.2 | 2.8 | | | | |
| 1.6 | 3.0 | | 2.5 | | 2.7 | 1.6 | 2.7 | 1 2 | 2.9 | | 2.9 | 1.1 | 1.8 | 1.8 | 2.6 | 1.2 | | | | |
| 0.0 | 1.2 | | 1.9 | | 2.4 | 0.8 | 3.2 | 2.0 | 2.2 | | 2.1 | 0.8 | 1.6 | 1.3 | 2.4 | 0.5 | | | | |
| 1.2 | 0.7 | | 1.1 | | 1.9 | 0.4 | 1.1 | | 1.6 | | 1.9 | 0.8 | 1.6 | 1.0 | 0.8 | 0.4 | | | | |
| 0.1 | 0.2 | | | | 1.2 | | 1.2 | | 1.0 | | 0.8 | | 1.4 | 0.6 | 0.3 | | | | | |
| | 0.2 | | | | 0.4 | | | | 0.5 | | 0.3 | | 1.0 | 0.3 | 0.4 | | | | | |
| | 0.1 | | | | 0.4 | | | | 0.3 | | | | 0.5 | 0.2 | | | | | | |
| | 0.1 | | | | | | | | | | | | | | | | | | | |

TABLE B.

*Obtained by Subtracting the Successive Ages in Table A (inches).*

| -g. | England. Robe'ts | | Engl'd. Anthro. Com. | | Belg'm. | | Turin. | | Lusan'e | | Freib'g. | | Breslau | | Gohlis. | | Posen. | | Hamb'g | | Saalfe'd | | Radom. | | Ha Sch Mo |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| | | | | | 7.8 | 7.8 | | | | | | | | | | | | | | | | | | | 7.2 |
| | | | | | 3.6 | 3.5 | | | | | | | | | | | | | | | | | | | 4.5 |
| | | | | | 2.9 | 2.9 | | | | | | | | | | | | | | | | | | | 3.7 |
| | | | 1.7 | 2.1 | 2.5 | 2.4 | 2.3 | 2.7 | | | | | | | | | | | | | | | | | 2.8 |
| | | | 2.5 | 2.3 | 2.4 | 2.3 | 2.0 | 2.0 | | | | | | | | | | | | | | | | | 2.6 |
| | 2.0 | | 3.0 | 2.3 | 2.3 | 2.3 | 2.5 | 2.2 | | | | | | | | | | | | | | | | | 2.3 |
| 1.2 | 1.8 | | 2.0 | 1.6 | 2.3 | 2.2 | 3.6 | 2.8 | | | 1.5 | 1.6 | 1.8 | | 1.6 | 1.8 | 2.1 | | | | 2.0 | 2.2 | | | 2.9 |
| 1.9 | 2.0 | | 1.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.5 | 2.0 | 1.9 | 2.0 | 1.8 | 2.0 | | 2.0 | 1.5 | 2.0 | | | | 2.2 | 1.7 | | | 1.7 |
| 2.0 | 2.2 | | 2.6 | 2.1 | 2.3 | 2.1 | 2.2 | 2.1 | 1.8 | 1.9 | 1.8 | 1.9 | 1.9 | | 1.8 | 2.5 | 1.9 | | | | 2.0 | 2.2 | | | 1.8 |
| 2.0 | 1.3 | | 2.1 | 2.4 | 2.1 | 2.1 | 1.0 | 2.5 | 1.7 | 2.0 | 1.5 | 1.8 | 1.9 | | 2.0 | 1.8 | 1.3 | | 0.9 | | 1.3 | 2.1 | 1.5 | | 1.7 |
| 1.2 | 1.0 | | 1.7 | 2.0 | 2.1 | 2.0 | 1.1 | 1.6 | 1.6 | 2.1 | 1.8 | 2.0 | 1.9 | | 1.3 | 2.1 | 1.8 | | 1.7 | | 1.8 | 1.7 | 1.6 | | 1.6 |
| 1.9 | 1.5 | | 1.5 | 3.6 | 1.9 | 2.0 | 1.7 | 2.1 | 1.7 | 2.2 | 1.9 | 1.7 | 1.9 | | 2.3 | 2.2 | 2.0 | | 1.9 | | 2.0 | 2.0 | 1.4 | | 1.7 |
| 1.2 | 2.9 | | 1.9 | 1.1 | 1.8 | 1.9 | 2.4 | 2.3 | 1.9 | 2.0 | 1.9 | 2.4 | 2.0 | | 1.0 | 2.2 | 1.9 | | 1.2 | | 1.7 | 2.2 | 2.4 | | 1.8 |
| 1.9 | 1.9 | | 2.4 | 2.0 | 1.8 | 1.8 | 2.2 | 2.8 | | | | | 2.3 | | | | | | 2.3 | | | | 2.2 | | 1.7 |
| 1.2 | 2.9 | | 2.0 | 1.1 | 1.8 | 1.8 | 2.6 | 1.2 | | | | | 3.0 | | | | | | 2.1 | | | | 2.8 | | 2.2 |
| 2.0 | 2.2 | | 2.1 | 0.8 | 1.6 | 1.3 | 2.4 | 0.5 | | | | | 2.4 | | | | | | 3.0 | | | | 2.0 | | |
| | 1.6 | | 1.9 | 0.8 | 1.6 | 1.0 | 0.8 | 0.4 | | | | | | | | | | | 2.0 | | | | 1.7 | | |
| | 1.0 | | 0.8 | | 1.4 | 0.6 | 0.3 | | | | | | | | | | | | | | | | 0.3 | | |
| | 0.5 | | 0.3 | | 1.0 | 0.3 | 0.4 | | | | | | | | | | | | | | | | | | |
| | 0.3 | | | | 0.5 | 0.2 | | | | | | | | | | | | | | | | | | | |

| n. | Halle. Schm't-Monn'd. | |
|---|---|---|
| F. | M. | F. |
| | 7.2 | 7.4 |
| | 4.5 | 3.0 |
| | 3.7 | 2.6 |
| | 2.8 | 3.2 |
| | 2.6 | 2.6 |
| | 2.3 | 2.4 |
| | 2.9 | 2.2 |
| | 1.7 | 1.7 |
| | 1.8 | 1.8 |
| | 1.7 | 1.6 |
| | 1.6 | 1.7 |
| | 1.7 | 1.7 |
| | 1.8 | 2.1 |
| | 1.7 | 1.9 |
| | 2.2 | 1.8 |

## TABLE C.

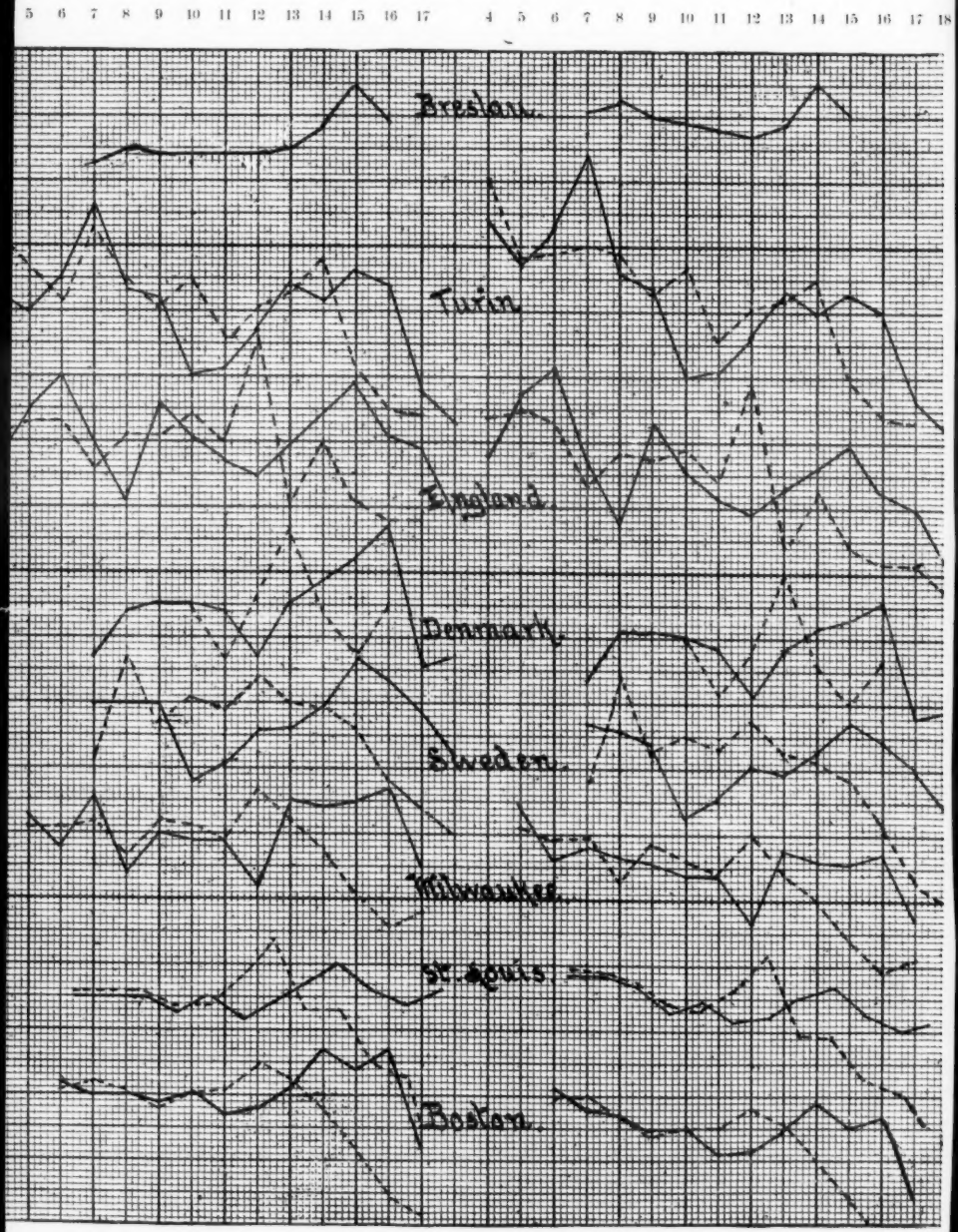
*Showing the Percentage of Increase in Height of each Year's Growth.*

| AGE. | Boston. | | St. Louis. | | Milwauk'e. | | Oakland. | | Worcester. | | New Haven. | | Moscow | | Sweden | | Denmark. | | Engl'd. Anthro. Com. | | Turin. | | Lausanne. | | Freib'g. | | Breslau | | Posen. | | Radom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| 0½— 1½ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1½— 2½ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2½— 3½ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3½— 4½ | | | | | | | | | | | | | | | | | | | 4.6 | 5.8 | 6.8 | 8.1 | | | | | | | | | | |
| 4½— 5½ | | | | | 5.9 | 5.2 | | | | | | | | | | | | | 6.5 | 6.0 | 5.5 | 5.6 | | | | | | | | | | |
| 5½— 6½ | 5.2 | 5.0 | | | 4.3 | 4.9 | | | 2.7 | 3.6 | | | | | | | | | 7.3 | 5.7 | 6.5 | 5.8 | | | | | | | | | | |
| 6½— 7½ | 4.6 | 5.0 | 4.7 | 4.9 | 4.6 | 4.9 | 2.0 | 1.1 | 3.8 | 5.7 | 4.7 | 4.5 | | | 4.4 | 2.7 | 2.7 | 2.7 | 4.5 | 3.7 | 8.8 | 7.0 | | | 3.5 | 3.8 | 4.1 | | 5.0 | | | |
| 7½— 8½ | 4.4 | 4.5 | 4.7 | 4.8 | 4.3 | 3.6 | 5.8 | 4.2 | 4.5 | 3.5 | 3.8 | 3.2 | 5.2 | 4.3 | 4.2 | 5.9 | 4.2 | 4.2 | 2.4 | 4.7 | 5.2 | 5.8 | 4.3 | 4.1 | 4.5 | 4.1 | 4.5 | | 4.5 | | | |
| 8½— 9½ | 4.0 | 3.8 | 4.4 | 4.5 | 4.1 | 4.7 | 3.6 | 5.1 | 3.8 | 3.9 | 4.7 | 5.0 | 4.1 | 2.8 | 4.0 | 3.3 | 4.2 | 4.2 | 5.5 | 4.5 | 4.7 | 4.6 | 3.7 | 4.0 | 3.9 | 4.1 | 4.0 | | 4.2 | | | |
| 9½—10½ | 4.0 | 4.0 | 3.6 | 3.9 | 3.7 | 4.2 | 5.3 | 4.7 | 5.5 | 5.0 | 3.5 | 3.9 | 6.6 | 4.5 | 1.6 | 4.0 | 4.1 | 4.1 | 4.2 | 4.9 | 2.0 | 5.3 | 3.4 | 4.0 | 3.1 | 3.8 | 3.9 | | 2.7 | | 3.0 | |
| 10½—11½ | 3.2 | 4.0 | 3.9 | 3.7 | 3.7 | 3.7 | 3.1 | 4.7 | 3.6 | 3.1 | 5.5 | 3.4 | 3.7 | 3.9 | 2.1 | 3.7 | 3.7 | 2.3 | 3.3 | 3.9 | 2.2 | 3.2 | 3.1 | 4.1 | 3.6 | 4.0 | 3.7 | | 3.7 | | 3.1 | |
| 11½—12½ | 3.3 | 4.6 | 3.3 | 4.4 | 2.3 | 5.0 | 3.0 | 5.0 | 3.1 | 5.8 | 2.0 | 6.0 | 3.4 | 2.3 | 3.0 | 4.5 | 2.3 | 3.6 | 2.8 | 6.8 | 3.3 | 4.1 | 3.2 | 4.1 | 3.7 | 3.3 | 3.6 | | 4.0 | | 2.7 | |
| 12½—13½ | 3.8 | 4.1 | 3.4 | 5.3 | 4.5 | 3.9 | 3.1 | 6.0 | 3.2 | 2.3 | 3.2 | 4.3 | 3.6 | 4.2 | 2.9 | 3.6 | 3.7 | 5.9 | 3.5 | 1.9 | 4.6 | 4.3 | 3.5 | 3.6 | 3.6 | 4.5 | 3.8 | | 3.5 | | 4.4 | |
| 13½—14½ | 4.7 | 3.1 | 4.0 | 2.9 | 4.2 | 3.1 | 5.1 | 2.0 | 4.5 | 3.9 | 0.9 | 1.7 | 3.3 | | 3.5 | 3.3 | 4.3 | 3.3 | 4.2 | 3.5 | 4.0 | 5.0 | | | | | 4.0 | | | | 3.9 | |
| 14½—15½ | 4.0 | 1.9 | 4.3 | 2.8 | 4.1 | 1.8 | 3.1 | 1.1 | 5.3 | 2.1 | 5.9 | 1.8 | 4.2 | | 4.6 | 2.7 | 4.6 | 2.0 | 4.9 | 1.8 | 4.5 | 2.0 | | | | | 5.0 | | | | 4.8 | |
| 15½—16½ | 4.3 | 0.8 | 3.5 | 1.6 | 4.4 | 0.9 | 4.4 | 1.3 | 2.2 | 0.9 | 4.6 | 0.0 | 3.1 | | 3.9 | 1.3 | 5.2 | 3.3 | 3.4 | 1.3 | 4.0 | 0.8 | | | | | 4.0 | | | | 3.3 | |
| 16½—17½ | 1.8 | 0.5 | 3.0 | 1.1 | 2.4 | 1.2 | 4.0 | 0.0 | 1.6 | 0.6 | 2.1 | 1.8 | 1.7 | | 3.0 | 0.6 | 1.7 | | 3.0 | 1.3 | 1.3 | 0.7 | | | | | | | | | 2.7 | |
| 17½—18½ | | | 3.2 | 0.1 | | | | | | | | | | | 1.8 | 0.0 | 1.8 | | 1.2 | | 0.5 | | | | | | | | | | 0.6 | |
| 18½—19½ | | | | | | | | | | | | | | | 0.6 | | | | 0.4 | | 0.6 | | | | | | | | | | | |
| 19½—20½ | | | | | | | | | | | | | | | 0.6 | | | | | | | | | | | | | | | | | |
| 20½—21½ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

CHART I.—RATE OF GROWTH IN HEIGHT.

CHART I.—RATE OF GROWTH IN HEIGHT.

Curves on left show the Absolute Annual Increases for places named taken from Table B; continuous lines represent averages for boys, dotted lines averages for girls. The smallest divisions of the ruled lines are millimeters; each millimeter in vertical height represents one-tenth of an inch in growth. Curves on right show the percentage annual increases taken from Table C; sexes indicated as above; each vertical distance of five millimeters represents 1 per cent. in growth.



son that he reckoned age by "the nearest birthday," while all others use the last birthday. Since an average of a year's ages is based upon children from the beginning to those born 364 days later, an average really gives, in all tables except that of Porter, the height of a child in the middle of the year. For example, the average height given of children 7 years really means the height of a child 7½ years, assuming of course that ages are evenly distributed in time. In the case of Dr. Porter, however, who counts as 7 years of age children 6½ to 7½ (*i. e.*, the nearest birthday), the average is at 7 years, or 6 months younger. This explanation also applies to the weights. In almost all investigations the children were measured without shoes. In one or two instances (*e. g.*, Gilbert) shoes were worn. So far as known, these facts are stated at the head of each column.

Table B shows the absolute annual increases obtained from Table A by subtracting the average height of one age from the next.

Table C gives the "percentage" or "relative" annual increase. The rate of increase has generally been determined merely by the absolute annual increase. But such a method neglects to take into account the different heights of the different years, and it is perhaps unfair to say because a large boy increases slightly more than a small boy, that therefore he is actually growing faster. Relative to their respective sizes in the beginning, the small child may make a larger increase in proportion to size. As Porter points out, it would be fairer to find in each case the percentage of his own size which each boy grows (by dividing the year's increase by the size at the beginning of the year). Minot also indorses the system of percentages. He says: "In the writings of Quetelet, Cowell, Roberts, Gould, Pagliani, Street, Boulton, Liharzik, Bowditch and others, the rate of growth is discussed, but I am compelled to consider that they have all misapplied the term. They compare the index of the rate, the actual, absolute increments of equal successive periods; but since during each period the size of the body increases, then if the rate of growth were constant, the proportionate increment would remain the same, but the absolute increments would become steadily larger. Reciprocally, it is evident from this that if the absolute increments are constant, the rate of growth diminishes, a point which, so far as I am aware, has been entirely overlooked hitherto."

Chart I represents graphically the increases in height.

In connection with the height, Chart III should be consulted, showing the growth in height of the average American child, and also his absolute and percentage annual increases.

## WEIGHT.

There has been some discussion upon the question whether height or weight is the better index of fundamental growth conditions. Donaldson (†[29]) decides in favor of weight, for the reason that while the body increases in stature from birth to thirty years only 3.37 fold, in volume the increase is 20.66 fold. He thinks, therefore, that weight is a better index of the complex changes which growth implies. His view is not held by the majority of anthropometrists. The general view is rather in favor of using height as the index. Increase in

([29]) Pp. 49-50.

weight varies irregularly throughout life, depending intimately upon external conditions. The absorption of water and the accumulations of fats which constitute elements not properly considered increments of permanent significance, render it impossible to determine the essential growth, by weight.

Vierordt ([94]) concludes that the average weight of the male at birth may be put at 3,333 grammes (7.3 lbs.), and of females at 3,200 grammes (7.1 lbs.)

Vierordt gives the following averages:

| | Boys. | Girls. |
|---|---|---|
| Spiegelberg, Breslau, | 3,201 gr. | 3,056 gr. |
| Gregory, Munich, | 3,355 | 3,386 |
| Schutz, Leipzig, | 3,399 | 3,233 |
| Ingerslev, | 3,381 | 3,280 |
| Kézmarsky, Perth, | 3,383 | 3,284 |
| Quetelet, Brussels, | 3,100 | 3,000 |
| Wagner, Königsberg, | 3,479 | 3,339 |

The Report of the Anthropometric Committee ([†27]) from data of 451 boys and 466 girls in London and Edinburgh hospitals, places the average of boys at 7.1 pounds and of girls at 6.9 pounds. Roberts ([†89]) from data of 100 English new-born children, finds that the boys range in weight from 3 to 12 pounds, but that 87 per cent. are between 6 and 9 pounds; the females range in weight from 4 to 11 pounds, and 85 per cent. are between 6 and 9 pounds. Elsässer, in Stuttgart, from 1,000 observations, finds that 976 children vary from 5 to 9 pounds (German).

Siebold, from data of 3,000 new-born infants, finds the extreme variations from 4 to 11 pounds (German); only 169 fall outside of the limits of 5½ to 8½ pounds. Fasbender ([93]) finds that first-born children average 189 grammes lighter than later born, but the relations seem to change later, for Boas ([14]) concludes that after the sixth year first-born children are heavier as well as taller than later born.

The development by weight seems, on the whole, to follow the law of development in height. The weight at birth is almost trebled during the first year. The rate of growth decreases very rapidly at first, more slowly later, and up to the period of maturity shows fluctuations indicative of periods of rapidity followed by periods of comparative rest.

The period of infantile growth in weight and that of the period up to six years will be found reviewed by Vierordt ([92], [94], [95]). The more important recent contributions are those of Camerer ([22], [23]) and of Daffner ([27]).

Up to the period of prepubertal growth, there is no material difference in the absolute average weight of the two sexes. At 6 years, a comparison of the average weights, as given in the table, will show that the sexes vary less than two pounds, with the advantage in favor of the boys. From six to ten

([27]) P. 34. ([†89]) P. 79.

TABLE E.

*Showing the Weight at Successive Ages in Differ*

| AGE. | Boston. (Bowd'h.)[18] 13,691 Boys. 10,904 Girls. | | St. Louis. (Porter.)[78] 16,295 Boys. 18,059 Girls. Age nearest Birthday. | | Milwaukee. (Peck'm.)[76] 4,773 Boys. 4,891 Girls. | | Oakland.[75] Number not Stated. | | Worcester. (West.)[102] 3,250 Children. | | New Haven (Gilbert.)[44] About 50 of each sex for each age. | | Iowa. (Gilbert.)[45] About 50 of each sex for each age. | | Pennsylv'a. (Hall.)[48] 2,434 Males (nude). | | Sweden Com'ission. (Key.)[58] 15,000 Boys. 3,000 Girls. | | Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls. | | Mos (Eris 2,45 1,40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| 0 | | | | | | | | | | | | | | | | | | | | | |
| 1½ | | | | | | | | | | | | | | | | | | | | | |
| 2½ | | | | | | | | | | | | | | | | | | | | | |
| 3½ | | | | | | | | | | | | | | | | | | | | | |
| 4½ | | | | | 38.8 | 36.3 | | | | | | | | | | | | | | | |
| 5½ | 41.1 | 39.7 | | | 41.1 | 40.0 | | | 42.63 | 39.36 | | | | | | | | | | | |
| 6½ | 45.2 | 43.3 | 43.7 | 41.7 | 44.8 | 43.1 | 47.6 | 45.9 | 46.04 | 43.70 | 46.8 | 44.3 | 45.9 | 41.6 | | | 45.2 | | 46.3 | 44.1 | 44.1 |
| 7½ | 49.1 | 47.5 | 47.8 | 45.9 | 49.1 | 47.0 | 50.2 | 48.1 | 49.37 | 47.96 | 51.2 | 50.4 | 51.4 | 47.4 | | | 53.3 | 47.6 | 49.6 | 47.4 | 48.5 |
| 8½ | 53.9 | 52.0 | 52.5 | 50.5 | 53.8 | 50.9 | 54.2 | 52.2 | 53.64 | 51.50 | 52.5 | 53.0 | 55.0 | 51.0 | | | 57.8 | 55.1 | 52.9 | 51.8 | 53.1 |
| 9½ | 59.2 | 57.1 | 57 5 | 55.3 | 59.5 | 56.4 | 59.6 | 58.6 | 59.81 | 57.37 | 60.0 | 58.8 | 61.6 | 58.1 | 58.4 | | 64.6 | 59.3 | 57.3 | 56.2 | 61.1 |
| 10½ | 65.3 | 62.4 | 62.4 | 60.6 | 65.4 | 62.4 | 66.7 | 63.2 | 66.51 | 63.52 | 68.4 | 62.7 | 63.7 | 62.1 | 66.1 | | 66.8 | 64.8 | 62.8 | 61.7 | 67.2 |
| 11½ | 70.2 | 68.8 | 68.3 | 66.6 | 70.9 | 68.8 | 72.0 | 69.7 | 71.00 | 69.94 | 70.8 | 70.0 | 72.4 | 69.2 | 71.7 | | 71.0 | 70.3 | 68.3 | 67.2 | 73.4 |
| 12½ | 76.9 | 78.3 | 73.9 | 74.3 | 76.1 | 77.8 | 77.9 | 78.9 | 78.75 | 79.74 | 82.3 | 84.5 | 78.2 | 79.7 | 80.5 | | 76.1 | 79.1 | 73.9 | 75.0 | 82.9 |
| 13½ | 84.8 | 88.7 | 80.7 | 84.9 | 84.9 | 88.0 | 89.4 | 90.7 | 86.13 | 87.66 | 88.0 | 92.0 | 90.9 | 94.1 | 89.7 | | 82.9 | 87.3 | 80.5 | 83.8 | 91.5 |
| 14½ | 94.9 | 98.4 | 89.1 | 93.3 | 95.8 | 97.6 | 97.0 | 98.2 | 98.18 | 99.10 | 91.7 | 98.0 | 102.0 | 99.9 | 99.6 | | 93.3 | 98.8 | 89.3 | 92.6 | 102.7 |
| 15½ | 107.1 | 106.1 | 101.9 | 103.0 | 109.0 | 105.9 | 108.1 | 108.9 | 112.2 | 105.0 | 110.0 | 104.0 | 117.0 | 111.3 | 108.7 | | 103.2 | 107.8 | 102.6 | 102.6 | 116.8 |
| 16½ | 121.0 | 112.0 | 113.8 | 110.9 | 122.1 | 110.6 | 121.6 | 109.8 | 123.6 | 109.0 | 127.0 | 113.0 | 130.0 | 111.6 | 125.7 | | 115.3 | 113.8 | 116.8 | 112.4 | 126.6 |
| 17½ | 127.5 | 115.5 | 122.8 | 116.0 | 130.4 | 113.3 | 131.7 | 117.7 | 132.9 | 115.0 | 130.0 | 113.7 | 140.1 | 121.0 | 133.8 | | 127.0 | 120.4 | 126.8 | | 132.5 |
| 18½ | 132.6 | 115.2 | | 115.5 | 137.8 | 112.5 | 137.7 | 118.3 | 133.2 | 120.0 | | | 142.6 | 125.5 | 138.7 | | 135.1 | 124.1 | 134.5 | | |
| 19½ | | | | 115.1 | | | | | 142.6 | 118.3 | | | 145.5 | 126.4 | 140.7 | | 139.6 | 126.6 | | | |
| 20½ | | | | 118.8 | | | | | | 119.8 | | | | | 142.6 | | 143.7 | 127.2 | | | |
| 21½ | | | | | | | | | | | | | | | 145.1 | | | | | | |

## TABLE E.

*...e Weight at Successive Ages in Different Countries and Cities (pounds).*

| ...[45] ...f ...r | Pennsylv'a. (Hall.)[48] 2,434 Males (nude). | | Sweden Com'ission. (Key.)[58] 15,000 Boys. 3,000 Girls. | | Denmark Com'ission. (Hertel.)[51] 17,134 Boys. 11,250 Girls. | | Moscow. (Erism'n)[31] 2,453 Boys. 1,495 Girls. | | Turin. (Paglia'i)[74] 1,048 Boys. 968 Girls. | | Gohlis. (Geissler)[43] 1,386 Boys. 1,420 Girls. | | Belgium. (Quete't.)[80] Selected Ten of each Age and Sex. | | England. (Robe'ts)[82] Over 10,000 Males. | | England. (Anthrop. Com.)[37] Over 30,000 Persons. | | Den... (V... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| | | | | | | | | | | | | | 6.8 | 6.6 | 7.6 | | 7.1 | 6.9 | |
| | | | | | | | | | | | | | 21.8 | 19.9 | | | | | |
| | | | | | | | | | | | | | 24.3 | 24.3 | | | | | |
| | | | | | | | | | 27.3 | 24.7 | | | 27.6 | 27.3 | | | 34.0 | 31.6 | |
| | | | | | | | | | 29.8 | 28.9 | | | 30.9 | 30.6 | 41.2 | | 37.3 | 36.1 | |
| | | | | | | | | | 33.5 | 33.1 | | | 35.1 | 33.7 | 50.0 | | 40.0 | 39.2 | |
| 3 | | | 45.2 | | 46.3 | 44.1 | 44.1 | 42.8 | 36.8 | 36.2 | 47.2 | 45.2 | 39.2 | 36.8 | 54.2 | | 44.4 | 41.7 | |
| 4 | | | 50.3 | 47.6 | 49.6 | 47.4 | 48.5 | 47.0 | 42.8 | 39.0 | 50.5 | 49.4 | 43.4 | 39.2 | 56.9 | | 50.0 | 47.5 | |
| 5 | | | 57.8 | 55.1 | 52.9 | 51.8 | 53.1 | 48.5 | 45.6 | 41.9 | 54.5 | 54.0 | 47.6 | 41.9 | 59.0 | | 54.9 | 52.1 | |
| 6 | 58.4 | | 64.6 | 59.3 | 57.3 | 56.2 | 61.1 | 58.4 | 49.4 | 48.3 | 58.9 | 57.8 | 51.8 | 46.3 | 62.6 | | 60.4 | 55.5 | |
| 7 | 66.1 | | 66.8 | 64.8 | 62.8 | 61.7 | 67.2 | 60.4 | 54.7 | 54.5 | 63.5 | 62.8 | 55.6 | 50.9 | 66.3 | | 68.0 | 62.0 | |
| 8 | 71.7 | | 71.0 | 70.3 | 68.3 | 67.2 | 73.4 | 66.8 | 58.6 | 59.3 | 70.5 | 69.7 | 59.5 | 56.2 | 69.5 | | 72.0 | 68.1 | |
| 9 | 80.5 | | 76.1 | 79.1 | 73.9 | 75.0 | 82.9 | 80.5 | 64.6 | 65.0 | 76.3 | 77.8 | 63.9 | 63.9 | 73.7 | | 76.7 | 76.4 | |
| 10 | 89.7 | | 82.9 | 87.3 | 80.5 | 83.8 | 91.5 | 89.3 | 72.8 | 76.1 | 79.4 | 85.1 | 73.0 | 71.7 | 78.3 | | 82.6 | 87.2 | |
| 11 | 99.6 | | 93.3 | 98.8 | 89.3 | 92.6 | 102.7 | 94.4 | 80.7 | 84.9 | | | 81.8 | 80.0 | 84.6 | | 92.0 | 96.7 | |
| 12 | 108.7 | | 103.2 | 107.8 | 102.6 | 102.6 | 116.8 | 99.9 | 92.2 | 96.6 | | | 90.8 | 88.2 | 96.8 | | 102.7 | 106.3 | |
| 13 | 125.7 | | 115.3 | 113.8 | 116.8 | 112.4 | 126.6 | 101.0 | 104.1 | 100.8 | | | 100.1 | 95.9 | 108.7 | | 119.0 | 113.1 | |
| 14 | 133.8 | | 127.0 | 120.4 | 126.8 | | 132.5 | | 116.2 | 104.7 | | | 109.6 | 103.2 | 116.4 | | 130.9 | 115.5 | |
| 15 | 138.7 | | 135.1 | 124.1 | 134.5 | | | | 118.6 | 107.1 | | | 118.8 | 109.8 | 123.3 | | 137.4 | 121.1 | |
| 16 | 140.7 | | 139.6 | 126.6 | | | | | 121.3 | | | | 127.0 | 114.9 | 128.4 | | 139.6 | 123.8 | |
| 17 | 142.6 | | 143.7 | 127.2 | | | | | | | | | 131.2 | 117.3 | 130.6 | | 143.3 | 123.4 | |
| 18 | 145.1 | | | | | | | | | | | | | | | | 145.2 | 121.8 | |

| | Denmark. (Vahl.)[92] | | Saalfeld. (Schmidt)[85] 4,699 Boys. 4,807 Girls. | | Radom. (Sulli-gowski.)[88] 1,133 Boys. | | Japan. (Miwa.)[71] 1,250 Boys. 2,890 Girls. | |
|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | 32.3 | | | | | 31.0 | 29.6 |
| | | 35.8 | | | | | 33.0 | 32.6 |
| | | 39.5 | | | | | 36.1 | 34.3 |
| | | 41.6 | 41.9 | 40.1 | | | 37.9 | 37.0 |
| | | 48.4 | 46.7 | 44.8 | | | 41.9 | 39.4 |
| | | 53.6 | 51.1 | 48.5 | | | 44.7 | 43.2 |
| | | 59.0 | 55.8 | 53.8 | 55.3 | | 49.3 | 48.1 |
| | | 64.9 | 58.6 | 58.6 | 61.8 | | 52.6 | 52.4 |
| | | 74.0 | 65.7 | 65.0 | 68.0 | | 57.2 | 57.6 |
| | | 80.6 | 71.0 | 72.1 | 73.4 | | 62.1 | 66.2 |
| | | 89.8 | 77.2 | 80.7 | 82.1 | | 72.1 | 73.3 |
| | | 101.3 | 79.8 | | 91.9 | | 83.4 | 85.6 |
| | | 108.6 | | | 103.6 | | 92.2 | 90.9 |
| | | 100.9 | | | 112.5 | | 100.1 | 93.3 |
| | | | | | 123.4 | | 109.5 | 99.6 |
| | | | | | 126.8 | | 108.3 | 100.8 |
| | | | | | 127.2 | | 112.1 | 99.5 |
| | | | | | 130.7 | | 111.9 | 101.3 |
| | | | | | 136.9 | | 112.5 | |

| Age. | Boston. | | St. Louis. | | Milwaukee. | | Oakland. | | Worc |
|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| 0½— 1½ | | | | | | | | | |
| 1½— 2½ | | | | | | | | | |
| 2½— 3½ | | | | | | | | | |
| 3½— 4½ | | | | | | | | | |
| 4½— 5½ | | | | | 2.3 | 3.7 | | | |
| 5½— 6½ | 4.1 | 3.7 | | | 3.7 | 3.1 | | | 3.4 |
| 6½— 7½ | 3.9 | 4.2 | 4.1 | 4.2 | 4.3 | 3.9 | | | 3.3 |
| 7½— 8½ | 4.9 | 4.6 | 4.7 | 4.6 | 4.7 | 3.9 | 4.0 | 4.1 | 4.3 |
| 8½— 9½ | 5.3 | 5.0 | 5.0 | 4.8 | 5.7 | 5.5 | 5.4 | 6.4 | 6.2 |
| 9½—10½ | 6.1 | 5.3 | 4.9 | 5.3 | 5.9 | 6.0 | 7.1 | 4.6 | 6.7 |
| 10½—11½ | 4.9 | 6.5 | 5.9 | 6.0 | 5.5 | 6.4 | 5.3 | 6.5 | 4.5 |
| 11½—12½ | 6.7 | 9.5 | 5.1 | 7.7 | 5.2 | 9.0 | 5.9 | 9.2 | 7.7 |
| 12½—13½ | 7.9 | 10.3 | 6.8 | 10.6 | 8.8 | 10.2 | 11.5 | 11.8 | 7.4 |
| 13½—14½ | 10.1 | 9.8 | 8.4 | 8.4 | 10.9 | 9.6 | 7.6 | 7.5 | 12.0 |
| 14½—15½ | 12.2 | 7.6 | 12.8 | 9.7 | 13.2 | 8.3 | 11.1 | 10.7 | 13.9 |
| 15½—16½ | 13.9 | 6.0 | 11.9 | 7.9 | 13.1 | 4.7 | 13.5 | 0.9 | 11.6 |
| 16½—17½ | 6.5 | 3.5 | 9.0 | 5.1 | 8.3 | 2.7 | 10.1 | 7.9 | 9.3 |
| 17½—18½ | | | | | 7.4 | | 6.0 | 0.6 | 0.3 |
| 18½—19½ | | | | | | | | | |
| 19½—20½ | | | | | | | | | |
| 20½—21½ | | | | | | | | | |
| 21½—22½ | | | | | | | | | |

TA

*Showing the Absolute Annual Increases in Weight (poun*

| Worcester. | | New Haven | | Iowa. | | Pennsyl'a | | Sweden. | | Denmark. | | Mos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. |
| 3.4 | 4.3 | | | | | | | | | | | |
| 3.3 | 4.3 | 4.4 | 6.1 | 5.6 | 5.8 | | | 5.1 | | 3.3 | 3.3 | 4.4 |
| 4.3 | 3.5 | 1.3 | 2.6 | 3.6 | 3.6 | | | 7.5 | 7.5 | 3.3 | 4.4 | 4.6 |
| 6.2 | 5.9 | 7.5 | 5.8 | 6.6 | 7.1 | | | 6.8 | 4.2 | 4.4 | 4.4 | 8.0 |
| 6.7 | 6.2 | 8.4 | 3.9 | 2.1 | 4.0 | 7.7 | | 2.2 | 5.5 | 5.5 | 5.5 | 6.1 |
| 4.5 | 6.4 | 2.4 | 7.3 | 8.7 | 7.1 | 5.6 | | 4.2 | 5.5 | 5.5 | 5.5 | 6.2 |
| 7.7 | 9.8 | 11.5 | 14.5 | 5.8 | 10.5 | 8.8 | | 5.1 | 8.8 | 5.6 | 7.8 | 9.5 |
| 7.4 | 7.9 | 5.7 | 7.5 | 12.7 | 14.4 | 9.2 | | 6.8 | 8.2 | 6.6 | 8.8 | 8.6 |
| 12.0 | 11.4 | 3.7 | 6.0 | 11.1 | 5.9 | 9.9 | | 10.4 | 11.5 | 8.8 | 8.8 | 11.2 |
| 13.9 | 5.9 | 18.3 | 6.0 | 15.0 | 11.3 | 9.1 | | 9.9 | 9.0 | 13.3 | 10.0 | 14.1 |
| 11.6 | 4.0 | 17.0 | 9.0 | 13.0 | 0.3 | 17.0 | | 12.1 | 6.0 | 14.2 | | 9.8 |
| 9.3 | 6.0 | 3.0 | 0.7 | 10.1 | 9.4 | 8.1 | | 11.7 | 6.6 | 10.0 | | 5.9 |
| 0.3 | 5.0 | | | 2.4 | 4.5 | 4.9 | | 8.1 | 3.7 | 7.7 | | |
| | | | | 2.9 | 0.9 | 2.0 | | 4.5 | 2.4 | | | |
| | | | | | | 1.9 | | 4.1 | 0.6 | | | |
| | | | | | | 2.5 | | | | | | |

## TABLE F.

*ute Annual Increases in Weight (pounds): Obtained by Subtracting Successive Weights in T*

| | Pennsyl'a | | Sweden. | | Denmark. | | Moscow. | | Turin. | | Gohlis. | | Belgium. | | England. Roberts. | | England Anthrop. Com. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| | | | | | | | | | | | | | 15.0 | 12.4 | | | | |
| | | | | | | | | | | | | | 2.5 | 5.3 | | | | |
| | | | | | | | | | | | | | 3.3 | 3.0 | | | | |
| | | | | | | | | | 2.5 | 4.2 | | | 3.3 | 3.3 | | | 3.3 | 4.5 |
| | | | | | | | | | 3.7 | 4.2 | | | 4.2 | 3.1 | | | 2.7 | 3.1 |
| | | | | | | | | | 3.3 | 3.1 | | | 4.1 | 3.1 | 4.2 | | 4.4 | 2.5 |
| 6 | | | 5.1 | | 3.3 | 3.3 | 4.4 | 4.2 | 6.0 | 2.8 | 3.3 | 4.2 | 4.2 | 2.4 | 2.7 | | 5.6 | 5.8 |
| 5 | | | 7.5 | 7.5 | 3.3 | 4.4 | 4.6 | 1.5 | 2.8 | 2.9 | 4.0 | 4.6 | 4.2 | 2.7 | 2.1 | | 4.9 | 4.6 |
| 8 | | | 6.8 | 4.2 | 4.4 | 4.4 | 8.0 | 7.9 | 3.8 | 6.4 | 4.4 | 3.8 | 4.2 | 4.4 | 3.6 | | 5.5 | 3.4 |
| 0 | 7.7 | | 2.2 | 5.5 | 5.5 | 5.5 | 6.1 | 4.6 | 5.3 | 6.2 | 4.6 | 5.0 | 3.8 | 4.6 | 3.7 | | 7.6 | 6.5 |
| 1 | 5.6 | | 4.2 | 5.5 | 5.5 | 5.5 | 6.2 | 6.4 | 3.9 | 4.8 | 7.0 | 6.9 | 3.9 | 5.3 | 3.2 | | 4.0 | 6.1 |
| 5 | 8.8 | | 5.1 | 8.8 | 5.6 | 7.8 | 9.5 | 13.7 | 6.0 | 5.7 | 5.8 | 8.1 | 4.4 | 7.7 | 4.2 | | 4.7 | 8.3 |
| 4 | 9.2 | | 6.8 | 8.2 | 6.6 | 8.8 | 8.6 | 8.8 | 8.2 | 11.1 | 3.1 | 7.3 | 9.1 | 7.8 | 4.6 | | 5.9 | 10.8 |
| 0 | 9.9 | | 10.4 | 11.5 | 8.8 | 8.8 | 11.2 | 5.1 | 7.9 | 8.8 | | | 8.8 | 8.3 | 6.3 | | 9.4 | 9.5 |
| 3 | 9.1 | | 9.9 | 9.0 | 13.3 | 10.0 | 14.1 | 5.5 | 11.5 | 11.7 | | | 9.0 | 8.2 | 12.2 | | 10.7 | 9.6 |
| 3 | 17.0 | | 12.1 | 6.0 | 14.2 | | 9.8 | 1.1 | 11.9 | 4.2 | | | 9.3 | 7.7 | 11.9 | | 16.3 | 6.8 |
| 4 | 8.1 | | 11.7 | 6.6 | 10.0 | | 5.9 | | 12.1 | 3.9 | | | 9.5 | 7.3 | 7.7 | | 11.9 | 2.4 |
| 5 | 4.9 | | 8.1 | 3.7 | 7.7 | | | | 2.4 | 2.4 | | | 9.3 | 6.6 | 6.9 | | 6.5 | 5.6 |
| 9 | 2.0 | | 4.5 | 2.4 | | | | | 2.7 | | | | 8.2 | 5.1 | 5.1 | | 2.2 | 2.7 |
| | 1.9 | | 4.1 | 0.6 | | | | | | | | | 4.2 | 2.4 | 2.2 | | 3.7 | |
| | 2.5 | | | | | | | | | | | | | | | | 1.9 | |
| | | | | | | | | | | | | | | | | | 1.7 | |

*ghts in Table E.*

| England Anthrop. Com. | | Hamburg. | | Saalfeld. | | Radom. | | Denmark. Vahl. | | Halle. | | Japan. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| | | | | | | | | | | 11.5 | 11.7 | | |
| | | | | | | | | | | 5.5 | 6.2 | | |
| | | | | | | | | | | 6.0 | 3.7 | | |
| 3.3 | 4.5 | | | | | | | | 3.5 | 4.0 | 4.0 | 2.0 | 3.0 |
| 2.7 | 3.1 | | | | | | | | 3.7 | 3.7 | 3.1 | 3.1 | 1.7 |
| 4.4 | 2.5 | | | | | | | | 2.1* | 4.2 | 4.2 | 1.8 | 2.7 |
| 5.6 | 5.8 | | | 4.8 | 4.7 | | | | 6.8 | 4.8 | 4.2 | 4.0 | 2.4 |
| 4.9 | 4.6 | | | 4.4 | 3.7 | | | | 5.2 | 3.3 | 0.1 | 2.8 | 3.8 |
| 5.5 | 3.4 | | | 4.7 | 5.3 | | | | 5.4 | 6.4 | 3.5 | 4.6 | 4.9 |
| 7.6 | 6.5 | 3.1 | | 2.8 | 4.8 | 6.5 | | | 5.9 | 4.4 | 4.8 | 3.3 | 4.3 |
| 4.0 | 6.1 | 5.3 | | 7.1 | 6.4 | 6.2 | | | 9.1 | 5.1 | 4.4 | 4.6 | 5.2 |
| 4.7 | 8.3 | 7.1 | | 5.3 | 7.1 | 5.4 | | | 6.6 | 6.0 | 5.5 | 4.9 | 8.6 |
| 5 9 | 10.8 | 4.2 | | 6.2 | 8.6 | 8.7 | | | 9.2 | 6.2 | 6.8 | 10.0 | 7.1 |
| 9.4 | 9.5 | 11.5 | | | | 9.8 | | | 11.5 | 10.1 | 8.6 | 11.3 | 12.3 |
| 10.7 | 9.6 | 10.8 | | | | 11.7 | | | 7.3 | | | 8.8 | 5.3 |
| 16.3 | 6 8 | 13.2 | | | | 8.9 | | | | | | 7.9 | 2.4 |
| 11.9 | 2.4 | 10.8 | | | | 10.9 | | | | | | 9.4 | 6.3 |
| 6.5 | 5.6 | 7.7 | | | | 3.4 | | | | | | | 1.2 |
| 2 2 | 2.7 | 3.3 | | | | 0.4 | | | | | | | |
| 3.7 | | 3.7 | | | | 3.5 | | | | | | | |
| 1.9 | | | | | | 6.2 | | | | | | | |
| 1.7 | | | | | | | | | | | | | |

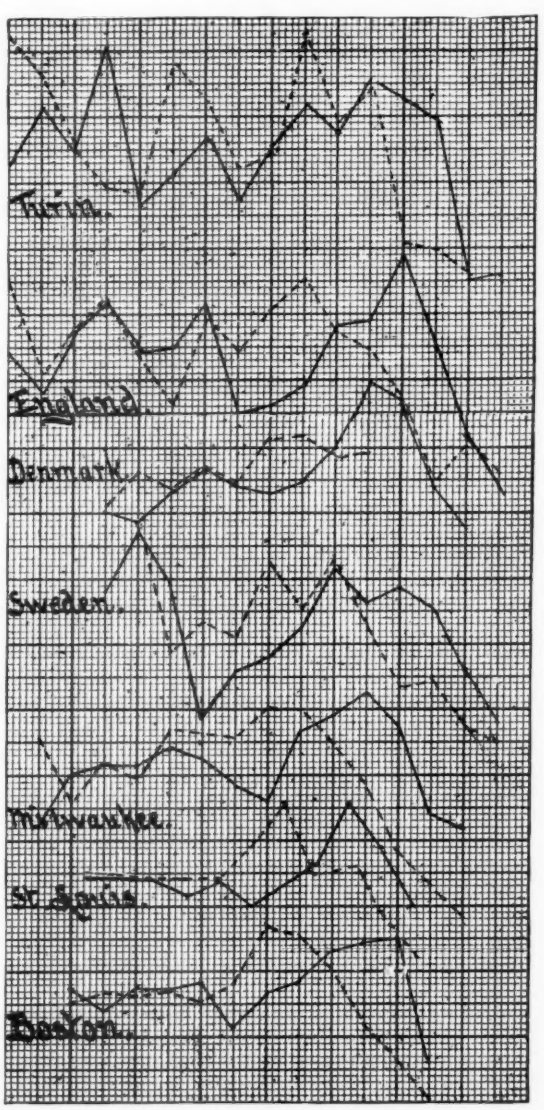
## TABLE G.

*Showing the Percentage of Increase of Weight.*

| AGE. | Boston. | | St. Louis. | | Milwaukee. | | Oakland. | | Worcester. | | New Haven | | Moscow. | | Sweden. | | Denmark. | | England. Anthrop. Com. | | Turin. | | Radom. | | Japan. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. | M. | F. |
| 3½— 4½ | | | | | | | | | | | | | | | | | | | 9.7 | 14.2 | 9.2 | 17.0 | | | 6.5 | 10.1 |
| 4½— 5½ | | | | | 5.8 | 10.2 | | | | | | | | | | | | | 7.2 | 8.6 | 12.4 | 14.5 | | | 9.4 | 5.2 |
| 5½— 6½ | 9.9 | 9.1 | | | 9.0 | 7.8 | | | 8.0 | 10.9 | | | | | | | | | 11.0 | 6.4 | 9.9 | 9.4 | | | 5.0 | 7.9 |
| 6½— 7½ | 8.6 | 9.7 | 9.7 | 10.0 | 9.6 | 9.8 | | | 7.2 | 9.8 | 9.4 | 13.8 | 10.0 | 9.8 | 11.3 | | 7.1 | 7.5 | 12.6 | 13.9 | 16.3 | 7.7 | | | 10.6 | 6.5 |
| 7½— 8½ | 9.9 | 9.6 | 9.7 | 9.9 | 9.6 | 8.9 | 8.0 | 8.5 | 8.7 | 7.3 | 2.5 | 5.2 | 9.5 | 3.3 | 14.9 | 15.7 | 6.7 | 9.3 | 9.8 | 9.7 | 6.5 | 7.4 | | | 6.7 | 9.6 |
| 8½— 9½ | 9.9 | 9.7 | 9.6 | 9.6 | 10.6 | 10.8 | 10.0 | 12.3 | 11.6 | 11.5 | 14.3 | 10.9 | 15.1 | 16.4 | 11.8 | 7.6 | 8.3 | 8.5 | 10.0 | 6.5 | 8.3 | 15.3 | | | 10.3 | 11.3 |
| 9½—10½ | 10.3 | 9.2 | 8.7 | 9.6 | 9.9 | 10.6 | 11.9 | 7.8 | 11.2 | 10.8 | 14.0 | 6.6 | 10.0 | 17.0 | 3.4 | 9.3 | 9.6 | 9.8 | 12.6 | 11.7 | 10.7 | 12.8 | 11.8 | | 6.7 | 8.9 |
| 10½—11½ | 7.5 | 10.4 | 9.5 | 9.7 | 8.4 | 10.2 | 7.9 | 10.3 | 6.8 | 10.1 | 3.5 | 11.6 | 9.2 | 10.6 | 6.3 | 8.5 | 8.8 | 8.9 | 5.9 | 9.8 | 7.1 | 8.8 | 10.0 | | 8.7 | 9.9 |
| 11½—12½ | 9.6 | 13.7 | 8.1 | 11.6 | 7.3 | 13.1 | 8.2 | 13.2 | 10.8 | 14.0 | 16.2 | 20.7 | 12.9 | 20.5 | 7.2 | 12.5 | 8.2 | 11.6 | 6.5 | 12.2 | 10.2 | 9.6 | 7.9 | | 8.6 | 14.9 |
| 12½—13½ | 10.3 | 13.2 | 9.3 | 14.3 | 11.6 | 13.0 | 14.8 | 15.0 | 9.4 | 9.9 | 6.9 | 8.9 | 10.4 | 11.0 | 8.9 | 10.3 | 8.9 | 11.7 | 7.7 | 14.1 | 12.7 | 17.1 | 11.9 | | 16.1 | 10.7 |
| 13½—14½ | 12.2 | 11.0 | 10.5 | 9.9 | 12.8 | 10.9 | 8.5 | 8.3 | 13.9 | 13.0 | 4.2 | 6.5 | 12 2 | 5.7 | 12.5 | 13.1 | 10.9 | 10.5 | 11.4 | 10.9 | 10.9 | 11.6 | 11.9 | | 15.7 | 16.8 |
| 14½—15½ | 12.8 | 7.8 | 14.3 | 10.4 | 13.9 | 8.5 | 11.4 | 10.9 | 13.2 | 5.9 | 20.0 | 6.1 | 13.7 | 5.8 | 10.6 | 9.2 | 14.9 | 10.8 | 11.6 | 9.9 | 14.2 | 13.8 | 12.8 | | 10.6 | 6.2 |
| 15½—16½ | 13.0 | 5.6 | 11.6 | 7.6 | 11.9 | 4.4 | 12.5 | 10.8 | 10.4 | 3.8 | 15.5 | 8.7 | 8.4 | 1.1 | 11.7 | 5.5 | 13.8 | | 15.7 | 6.4 | 12.9 | 4.3 | 8.6 | | 8.6 | 2.6 |
| 16½—17½ | 5.4 | 3.1 | 7.9 | 4.7 | 6.6 | 2.4 | 8.3 | 7.2 | 7.5 | 5.5 | 2.4 | 0.6 | 4.7 | 3.3 | 10.1 | 5.8 | 8.6 | | 10.0 | 2.1 | 11.6 | 3.9 | 9.7 | | 9.4 | 6.8 |
| 17½—18½ | | | | | 5.7 | 0.6 | 4.6 | 0.5 | 0.2 | 4.3 | | | | 3.0 | 6.4 | 3.1 | 6.1 | | 5.0 | 4.8 | 2.1 | 2.3 | 2.8 | | | 1.2 |
| 18½—19½ | | | | | | | | | | | | | | | 3.3 | 2.0 | | | 1.6 | 2.2 | 2.3 | | 0.3 | | | |
| 19½—20½ | | | | | | | | | | | | | | | 2.9 | 0.5 | | | 2.6 | | | | 2.8 | | | |
| 20½—21½ | | | | | | | | | | | | | | | | | | | 1.3 | | | | 4.7 | | | |

CHART II.—RATE OF GROWTH IN WEIGHT.

Curves show the Percentage Annual Increases taken from Table G; continuous lines represent averages for boys, dotted lines for girls; each vertical distance of five millimeters represents 2 per cent. in growth.



years the increase weight in pounds is as follows for American investigations:

| | Boston. (Bowditch) | St. Louis. (Porter.) | Milwaukee. (Peckham.) | Oakland. | Worcester. (West.) | New Haven. (Gilbert.) |
|---|---|---|---|---|---|---|
| Boys, | 20.1 | 18.7 | 20.6 | 19.1 | 19.0 | 21.6 |
| Girls, | 19.1 | 18.9 | 19.4 | 17.3 | 19.5 | 18.4 |

There seem to be one or two fluctuations of weights, periods of activity and of rest, apparently between six years and the prepubertal acceleration. This is more marked and more irregular in girls than in boys. As a rule in the case of boys there is to be observed a general rising tendency culminating usually in the 8th, 9th or 10th year, followed by a sudden decrease to its lowest point just before the prepubertal increase. In the case of girls, the ebb tide of growth preceding the prepubertal acceleration is easily distinguishable in all the curves, but the previous rhythms are more irregular. The acceleration period in boys begins from the 11th to 13th year, and ends usually with the 16th, the year of maximum increase being the 14th, 15th or 16th. In the case of girls, the beginning is a year or two earlier than in boys, and is ended usually in the 14th or 15th. It is shorter in duration than the same period in boys.

As in growth in height, owing to the fact that the girls' acceleration begins and ends earlier than that of boys, girls are taller than boys for a period of two or three years. It is interesting to note that this law holds for the Japanese ([71]), a race distinct from the Europeans. The acceleration in girls begins in the 11th year, and they surpass boys in weight until the 15th. This phenomenon and the period of appearance seem practically identical with the form among American children.

Table E corresponds to Table A in heights. The same explanations there made apply here. The usual clothing worn is that of light indoor dress, but of course this varies in different countries and at different seasons of the year. Table F gives the absolute annual increases and Table G the percentage or relative annual increases computed on the same principle as Tables B and C already explained.

## The "Average" American Boy and Girl.

Dr. Franz Boas has suggested the feasibility and mathematical propriety of constructing the curve of growth for the

American child by massing the returns from the various localities. Of course the data of a large number of localities are not yet at hand. But the large studies which have been made in Boston, St. Louis, Milwaukee and others have justified a beginning.

TABLE H.

*Showing the Average American Height Mathematically Calculated by Dr. Franz Boas from the Data of 45,151 Boys and 43,298 Girls in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto, and Oakland (Cal.); also the Absolute and the Percentage Annual Increases of same.*

| Approximate Average Age. | Boys. | | | | Girls. | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Observations. | Average for each Year. Inches. | Absolute Annual Increase. Inches. | Perc'tage Annual Increase. Per cent. | Number of Observations. | Average for each Year. Inches. | Absolute Annual Increase. Inches. | Perc'tage Annual Increase. Per cent. |
| 5½ | 1,535 | 41.7 | | | 1,260 | 41.3 | | |
| | | | 2.2 | 5.3 | | | 2.0 | 4.8 |
| 6½ | 3,975 | 43.9 | | | 3,618 | 43.3 | | |
| | | | 2.1 | 4.8 | | | 2.4 | 5.5 |
| 7½ | 5,379 | 46.0 | | | 4,913 | 45.7 | | |
| | | | 2.8 | 6.1 | | | 2.0 | 4.4 |
| 8½ | 5,633 | 48.8 | | | 5,289 | 47.7 | | |
| | | | 1.2 | 2.5 | | | 2.0 | 4.2 |
| 9½ | 5,531 | 50.0 | | | 5,132 | 49.7 | | |
| | | | 1.9 | 3.8 | | | 2.0 | 4.0 |
| 10½ | 5,151 | 51.9 | | | 4,827 | 51.7 | | |
| | | | 1.7 | 3.3 | | | 2.1 | 4.1 |
| 11½ | 4,759 | 53.6 | | | 4,507 | 53.8 | | |
| | | | 1.8 | 3.4 | | | 2.3 | 4.3 |
| 12½ | 4,205 | 55.4 | | | 4,187 | 56.1 | | |
| | | | 2.1 | 3.8 | | | 2.4 | 4.3 |
| 13½ | 3,573 | 57.5 | | | 3,411 | 58.5 | | |
| | | | 2.5 | 4.3 | | | 1.9 | 3.2 |
| 14½ | 2,518 | 60.0 | | | 2,537 | 60.4 | | |
| | | | 2.9 | 4.8 | | | 1.2 | 2.0 |
| 15½ | 1,481 | 62.9 | | | 1,656 | 61.6 | | |
| | | | 2.0 | 3.2 | | | 0.6 | 1.0 |
| 16½ | 753 | 64.9 | | | 1,171 | 62.2 | | |
| | | | 1.6 | 2.5 | | | 0.5 | 0.8 |
| 17½ | 429 | 66.5 | | | 790 | 62.7 | | |
| | | | 0.9 | 1.4 | | | | |
| 18½ | 229 | 67.4 | | | | | | |

Tables H and I and Chart III show the growths in height and weight and the annual absolute and proportional increases for what might be termed the "average" American boy and girl. The average in Table I (weight) has been calculated by the mathematician, M. de Perott, upon the follow-

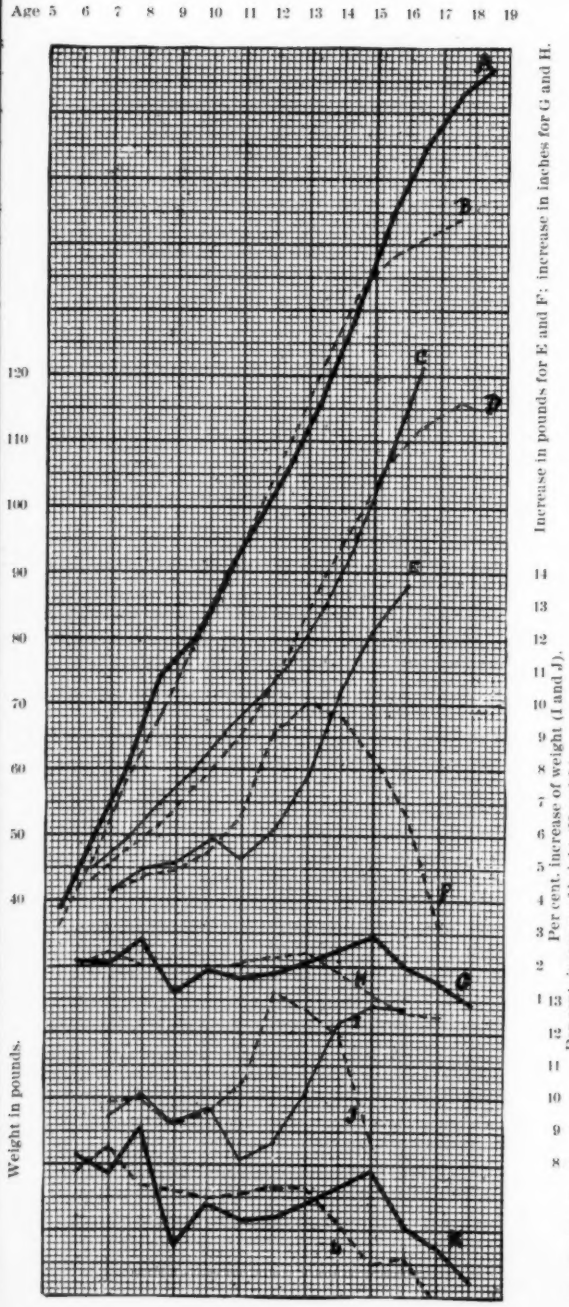



CHART III.

Showing growth curves average American boy a girl; continuous lines rep sent boys, and dotted li girls in all cases. Curves and B are constructed fr the average yearly height Table H; C and D from av age yearly weight of Table E and F from absolute a nual increases in weight Table I; G and H from a solute annual increases height of Table H; I an from annual percentage i creases in weight of Table and K L from annual p centage increases in hei of Table H.

The column of figures on treme left represents inc and applies to curves A a B; the second column on l represents pounds and appl to curves C and D; the in column on the right rep sents either pounds or inch of absolute increase, acco ing as they are applied curves E and F, and G a H respectively; the seco column on right expres the percentage increases weight applying to curve and J; the column on treme right expresses p centage increases of hei applying to curves K and

TABLE I.

*Showing the Average American Weight Mathematically Calculated from the Data of about 68,000 Children in the Cities of Boston, St. Louis and Milwaukee; also Absolute and Percentage Annual Increases of same.*

| AGE. | BOYS. | | | GIRLS. | | |
|---|---|---|---|---|---|---|
| | Average for each Age. Pounds. | Absolute Annual Increase. Pounds. | Annual Increase. Per Cent. | Average for each Age. Pounds. | Absolute Annual Increase. Pounds. | Annual Increase. Per Cent. |
| 6½ | 45.2 | .... | .... | 43.4 | .... | .... |
| 7½ | 49.5 | 4.3 | 9.5 | 47.7 | 4.3 | 9.9 |
| 8½ | 54.5 | 5.0 | 10.1 | 52.5 | 4.8 | 10.0 |
| 9½ | 59.6 | 5.1 | 9.3 | 57.4 | 4.9 | 9.3 |
| 10½ | 65.4 | 5.8 | 9.7 | 62.9 | 5.5 | 9.6 |
| 11½ | 70.7 | 5.3 | 8.1 | 69.5 | 6.6 | 10.5 |
| 12½ | 76.9 | 6.2 | 8.7 | 78.7 | 9.2 | 13.2 |
| 13½ | 84.8 | 7.9 | 10.3 | 88.7 | 10.0 | 12.7 |
| 14½ | 95.2 | 10.4 | 12.3 | 98.3 | 9.6 | 11.9 |
| 15½ | 107.4 | 12.2 | 12.8 | 106.7 | 8.4 | 8.5 |
| 16½ | 121.0 | 13.6 | 12.7 | 112.3 | 5.6 | 5.2 |
| 17½ | .... | .... | .... | 115.4 | 3.1 | 2.8 |
| 18½ | .... | .... | .... | 114.9 | .... | .... |

ing plan: The averages given by Bowditch from 24,500 children of Boston, by Porter from 34,500 children of St. Louis, and by Peckham from 9,600 children of Milwaukee—making nearly 69,000 children all together — have been thrown together, but not averaged directly. At each age the number of children has been massed from these three sources and each of the three averages allowed to influence the average of the whole in proportion to the number of children each city contributes. Thus, for example, suppose at the age of 10 years St. Louis contributes 5,000 children, Boston 4,000 and Milwaukee 1,000 — altogether there would be 10,000 children of that age—the averages of the three cities would therefore influence the final average in the ratio of 5, 4 and 1, on the same principle we use in partnership.

By the generous courtesy of Dr. Franz Boas the writer is able to present the average heights (in Table H) from a still larger area and larger number of children. Dr. Boas, in an article in the Report of the Commissioner of Education (1896-7) which is shortly to appear, has made an average of the returns from six American cities—Boston, St. Louis, Milwaukee, Toronto, Worcester, and Oakland, Cal. The averages which form the basis are those of Drs. Bowditch, Porter, Peckham and West, and are given in Table A, with exception of the Toronto measurements contained in an, as yet, unpublished study by Dr. Boas. The computation, the writer presumes, has been made upon an identical or similar principle to that used by M. de Perott.

## Individual Variations in Height and Weight.

In dealing with averages we must not lose sight of individual variations. The value of averages for practical application to individual children has been a keenly disputed problem ever since Quetelet propounded his theory of types. The problem from a mathematical standpoint will be found elaborately discussed by a variety of different writers.* Individual children of normal rate of growth show a comparatively wide range of deviation at any given period, and also a wide deviation in reaching the crises in the periods of growth.

These variations will be shown by consulting the tables upon Galton's percentile grade system in Porter's "Growth of St. Louis Children," or in the special arrangement of his original data in this form that Bowditch has given in the Twenty-second Annual Report of the Massachusetts Board of Health, 1890.

What may be a still simpler arrangement to show individual variations in height and weight at a given age will be found by Bowditch's original article in his Tables Nos. 4-15. Gilbert in his New Haven and Iowa studies, finds that, on the whole, the variation increases with age, showing a noticeable enlargement during the periods of fastest growth. Previous to 11 years, the variations for boys and girls are about on an equality. In both sexes, Gilbert's curves of mean variation increase quite steadily until the 15th ye[illegible]d then fall off rapidly. This applies for both height and weight. Boys, as a rule, vary more than girls.

From the article by Dr. Franz Boas in the issue of the Report of the Commissioner of Education (1896-7) Tables J and K have been adapted by a reduction of centimeters to inches. The tables are based upon the massing by Dr. Boas of the

*Among recent writers dealing directly with the significance of averages of children's growth, the following references will be found valuable: Boas, *Science*, May 6, 1892, May 20, 1892, Dec. 23, 1892; Porter ([87, 78]), Bowditch ([18, 90]), Landsberger, Hall, Peckham, Hansen; Galton, "Natural Inheritance."

## TABLE J.

*Showing the Frequency of Stature of Boys of Different Ages mathematically Calculated by Dr. Franz Boas from Data Furnished by the Measurement of 45,151 Boys in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland (Cal.). (Adapted from centimeters to inches.)*

| Age in Years. | 5.589 | 6.536 | 7.511 | 8.504 | 9.496 | 10.494 | 11.492 | 12.489 | 13.481 | 14.467 | 15.454 | 16.445 | 17.453 | 18.424 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cm. Inches. | | | | | | | | | | | | | | |
| 91 35.83 | 0.4 | | | | | | | | | | | | | |
| 93 36.61 | 0.6 | | | | | | | | | | | | | |
| 95 37.40 | 1.7 | 0.1 | | | | | | | | | | | | |
| 97 38.19 | 3.5 | 0.4 | | | | | | | | | | | | |
| 99 38.98 | 6.7 | 0.7 | | | | | | | | | | | | |
| 101 39.76 | 10.7 | 2.2 | 0.2 | 0.1 | 0.1 | | | | | | | | | |
| 103 40.56 | 15.3 | 4.9 | 0.8 | 0.1 | 0.1 | | | | | | | | | |
| 105 41.34 | 16.9 | 9.0 | 2.0 | 0.4 | 0.1 | | | | | | | | | |
| 107 42.13 | 13.7 | 12.2 | 3.3 | 0.5 | 0.1 | | | | | | | | | |
| 109 42.91 | 13.3 | 15.5 | 6.2 | 1.3 | 0.1 | 0.1 | 0.1 | | | | | | | |
| 111 43.70 | 9.1 | 15.8 | 11.1 | 2.5 | 0.3 | 0.1 | 0.1 | | | | | | | |
| 113 44.49 | 4.3 | 13.5 | 13.0 | 4.6 | 0.8 | 0.1 | 0.1 | | | | | | | |
| 115 45.28 | 2.3 | 10.9 | 14.8 | 7.7 | 1.6 | 0.4 | 0.1 | | | | | | | |
| 117 46.06 | 0.9 | 6.9 | 14.7 | 11.3 | 4.1 | 0.7 | 0.2 | | | | | | | |
| 119 46.85 | 0.5 | 4.1 | 12.5 | 14.3 | 6.9 | 1.8 | 0.2 | 0.1 | 0.1 | | | | | |
| 121 47.64 | 0.2 | 2.2 | 9.1 | 15.0 | 10.3 | 3.7 | 0.7 | 0.2 | 0.1 | 0.1 | | | | |
| 123 48.43 | | 0.9 | 5.9 | 3.5 | 12.9 | 6.0 | 1.8 | 0.5 | 0.2 | 0.1 | 0.1 | | | |
| 125 49.21 | | 0.3 | 3.4 | 10.5 | 13.8 | 8.8 | 3.1 | 0.8 | 0.2 | 0.1 | | | | |
| 127 50.00 | | 0.3 | 11.8 | 7.9 | 13.9 | 11.1 | 6.0 | 1.9 | 0.7 | 0.2 | | | | |
| 129 50.79 | | 0.1 | 0.7 | 4.8 | 12.0 | 12.8 | 8.5 | 3.5 | 1.0 | 0.2 | | | | |
| 131 51.57 | | | 0.3 | 2.7 | 9.2 | 12.7 | 9.6 | 5.3 | 1.6 | 0.4 | | | | |
| 133 52.37 | | | 0.2 | 1.5 | 6.3 | 12.3 | 12.0 | 7.7 | 2.8 | 0.8 | 0.1 | | | |
| 135 53.15 | | | | 0.7 | 3.5 | 10.5 | 13.5 | 10.5 | 4.8 | 1.2 | 0.3 | | | |
| 137 53.94 | | | | 0.4 | 2.0 | 7.6 | 11.9 | 10.8 | 6.1 | 2.5 | 0.6 | 0.1 | 0.2 | |
| 139 44.72 | | | | 0.1 | 1.0 | 5.0 | 10.4 | 12.5 | 8.8 | 3.6 | 1.5 | 0.4 | | |
| 141 55.51 | | | | 0.1 | 0.4 | 3.1 | 8.6 | 11.3 | 10.1 | 5.2 | 2.2 | 0.4 | | |
| 143 56.30 | | | | | 0.3 | 1.8 | 5.3 | 9.9 | 10.8 | 5.6 | 2.2 | 0.7 | | |
| 145 57.09 | | | | | 0.1 | 0.7 | 3.2 | 7.7 | 10.5 | 8.0 | 3.2 | 0.7 | 0.3 | |
| 147 57.87 | | | | | 0.1 | 0.4 | 2.1 | 5.9 | 9.3 | 9.1 | 4.2 | 0.8 | 0.3 | |
| 149 58.66 | | | | | | 0.3 | 1.2 | 4.3 | 8.6 | 10.0 | 6.1 | 2.3 | 0.3 | 0.4 |
| 151 59.45 | | | | | | 0.1 | 0.7 | 2.7 | 6.3 | 8.2 | 7.3 | 2.8 | 0.7 | 0.4 |
| 153 60.24 | | | | | | | 0.3 | 1.8 | 5.3 | 8.8 | 7.6 | 2.7 | 1.4 | 0.9 |
| 155 61.02 | | | | | | | 0.1 | 1.2 | 4.9 | 8.3 | 7.8 | 4.9 | 1.6 | 2.2 |
| 157 61.81 | | | | | | | 0.1 | 0.6 | 3.1 | 6.2 | 8.2 | 5.8 | 3.9 | 1.8 |
| 159 62.60 | | | | | | | 0.1 | 0.5 | 1.7 | 5.7 | 8.6 | 8.0 | 5.4 | 2.6 |
| 161 63.39 | | | | | | | | 0.2 | 1.1 | 4.7 | 8.1 | 8.4 | 5.8 | 3.9 |
| 163 64.17 | | | | | | | | 0.1 | 0.7 | 3.7 | 6.6 | 10.5 | 8.9 | 9.2 |
| 165 64.96 | | | | | | | | | 0.4 | 2.4 | 6.9 | 10.1 | 11.4 | 9.2 |
| 167 65.75 | | | | | | | | | 0.2 | 1.5 | 6.0 | 10.2 | 10.3 | 10.5 |
| 169 66.54 | | | | | | | | | 0.3 | 1.4 | 4.7 | 10.5 | 10.5 | 10.9 |
| 171 67.32 | | | | | | | | | 0.1 | 0.9 | 3.3 | 8.6 | 9.6 | 13.5 |
| 173 68.11 | | | | | | | | | | 0.5 | 2.0 | 4.5 | 9.3 | 9.6 |
| 175 68.90 | | | | | | | | | | 0.2 | 1.1 | 3.0 | 7.2 | 8.3 |
| 177 69.68 | | | | | | | | | | 0.2 | 0.6 | 2.7 | 5.1 | 5.2 |
| 179 70.47 | | | | | | | | | | 0.1 | 0.4 | 1.2 | 4.2 | 4.8 |
| 181 71.26 | | | | | | | | | | | 0.1 | 0.5 | 2.3 | 6.1 |
| 183 72.05 | | | | | | | | | | | | 0.1 | 0.5 | |
| 185 72.83 | | | | | | | | | | | | 0.1 | 0.5 | |
| 187 73.62 | | | | | | | | | | | | | | 0.4 |
| 189 74.41 | | | | | | | | | | | | | 0.3 | |
| No. of Boys. | 1,535 | 3,975 | 5,379 | 5,633 | 5,531 | 5,151 | 4,759 | 4,205 | 3,573 | 2,518 | 1,481 | 753 | 429 | 229 |
| Corrected Mean Variation (cm.). | 4.80 | 4.92 | 5.22 | 5.53 | 5.66 | 5.90 | 6.32 | 6.80 | 7.71 | 8.66 | 8.87 | 7.75 | 7.23 | 6.74 |

## TABLE K.

*Showing the Frequency of Stature of Girls of Different Ages Mathematically Calculated by Dr. Franz Boas from the Data Furnished by the Measurement of 43,298 Girls in the Cities of Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland (Cal.). (Adapted from centimeters to inches.)*

| Age in Years. | | 5.611 | 6.545 | 7.513 | 8.501 | 9.497 | 10.495 | 11.494 | 12.490 | 13.479 | 14.471 | 15.466 | 16.473 | 17.466 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cm. | Inches. | | | | | | | | | | | | | |
| 91 | 35.83 | 0.1 | 0.1 | | | | | | | | | | | |
| 93 | 36.61 | 0.9 | 0.1 | | | | | | | | | | | |
| 95 | 37.40 | 2.2 | 0.1 | | | | | | | | | | | |
| 97 | 38.19 | 4.6 | 0.6 | | | | | | | | | | | |
| 99 | 38.98 | 9.4 | 1.5 | | 0.1 | | | | | | | | | |
| 101 | 39.76 | 12.3 | 3.5 | 0.3 | 0.1 | 0.1 | | | | | | | | |
| 103 | 40.55 | 17.1 | 6.7 | 1.3 | 0.1 | 0.1 | | | | | | | | |
| 105 | 41.34 | 16.8 | 10.2 | 2.5 | 0.3 | 0.1 | | | | | | | | |
| 107 | 42.13 | 13.9 | 13.9 | 4.3 | 0.6 | 0.3 | 0.1 | | | | | | | |
| 109 | 42.91 | 11.1 | 17.1 | 8.3 | 2.0 | 0.1 | 0.1 | | | | | | | |
| 111 | 43.70 | 6.0 | 14.8 | 11.4 | 3.8 | 0.4 | 0.1 | | | | | | | |
| 113 | 44.49 | 2.9 | 11.3 | 13.0 | 6.0 | 1.2 | 0.2 | 0.1 | 0.1 | | | | | |
| 115 | 45.28 | 1.9 | 9.1 | 15.4 | 9.3 | 2.8 | 0.5 | 0.2 | 0.1 | | | | | |
| 117 | 46.06 | 0.4 | 6.0 | 13.3 | 11.8 | 4.7 | 1.1 | 0.2 | 0.1 | 0.1 | | | | |
| 119 | 46.85 | 0.1 | 2.7 | 12.0 | 14.4 | 7.9 | 2.4 | 0.4 | 0.1 | 0.1 | | | | |
| 121 | 47.64 | 0.2 | 1.3 | 9.0 | 14.2 | 11.0 | 4.3 | 1.2 | 0.3 | 0.1 | | | | |
| 123 | 48.43 | | 0.5 | 4.5 | 12.5 | 13.2 | 6.3 | 1.9 | 0.4 | 0.1 | | | | |
| 125 | 49.21 | | 0.2 | 2.8 | 9.9 | 14.2 | 9.5 | 3.2 | 0.7 | 0.1 | 0.1 | | | |
| 127 | 50.00 | | 0.1 | 1.1 | 6.9 | 14.0 | 11.2 | 5.4 | 1.4 | 0.2 | 0.1 | | | |
| 129 | 50.79 | | 0.1 | 0.5 | 2.4 | 11.1 | 13.2 | 7.9 | 2.6 | 0.4 | 0.1 | | | |
| 131 | 51.57 | | | 0.2 | 2.1 | 7.9 | 13.0 | 10.1 | 3.9 | 0.8 | 0.2 | | | |
| 133 | 52.37 | | | 0.1 | 0.9 | 4.7 | 11.7 | 11.7 | 5.6 | 1.3 | 0.4 | | | |
| 135 | 53.15 | | | | 0.4 | 3.0 | 9.2 | 11.7 | 7.5 | 2.6 | 0.6 | | | |
| 137 | 53.94 | | | | 0.3 | 1.7 | 6.7 | 10.4 | 9.1 | 4.4 | 0.9 | 0.2 | | |
| 139 | 54.72 | | | | 0.1 | 1.0 | 4.4 | 10.4 | 10.4 | 5.6 | 1.7 | 0.7 | 0.2 | |
| 141 | 55.51 | | | | | 0.3 | 2.8 | 8.3 | 11.4 | 6.5 | 2.6 | 0.7 | 0.2 | 0.1 |
| 143 | 56.30 | | | | | 0.1 | 1.7 | 6.0 | 10.3 | 7.8 | 3.5 | 1.5 | 0.8 | 0.3 |
| 145 | 57.09 | | | | | 0.1 | 0.7 | 4.2 | 9.0 | 10.8 | 5.6 | 2.6 | 2.0 | 1.0 |
| 147 | 57.87 | | | | | | 0.4 | 2.6 | 7.2 | 9.3 | 7.0 | 3.8 | 2.6 | 2.4 |
| 149 | 58.66 | | | | | | 0.2 | 2.1 | 6.2 | 11.2 | 10.2 | 7.8 | 5.4 | 4.4 |
| 151 | 59.45 | | | | | | 0.1 | 1.0 | 4.8 | 10.5 | 12.4 | 10.2 | 8.2 | 6.7 |
| 153 | 60.24 | | | | | | | 0.4 | 3.4 | 8.4 | 12.8 | 12.1 | 11.0 | 8.4 |
| 155 | 61.02 | | | | | | | 0.3 | 2.4 | 7.6 | 13.4 | 15.3 | 12.9 | 10.8 |
| 157 | 61.81 | | | | | | 0.1 | 0.2 | 1.6 | 4.9 | 9.3 | 11.8 | 12.7 | 16.1 |
| 159 | 62.60 | | | | | | | 0.1 | 0.8 | 3.4 | 7.4 | 11.2 | 13.8 | 13.5 |
| 161 | 63.39 | | | | | | | | 0.3 | 2.0 | 5.1 | 8.9 | 11.3 | 13.8 |
| 163 | 64.17 | | | | | | | | 0.1 | 1.0 | 3.0 | 5.9 | 7.3 | 7.1 |
| 165 | 64.96 | | | | | | | | 0.1 | 0.4 | 1.9 | 3.5 | 5.8 | 7.1 |
| 167 | 65.75 | | | | | | | | 0.1 | 0.2 | 0.8 | 2.2 | 2.9 | 3.5 |
| 169 | 66.54 | | | | | | | | | 0.1 | 0.5 | 0.7 | 1.4 | 2.4 |
| 171 | 67.32 | | | | | | | | | 0.1 | 0.2 | 0.5 | 1.2 | 1.1 |
| 173 | 68.11 | | | | | | | | | | 0.2 | 0.2 | 0.2 | 0.5 |
| 175 | 68.90 | | | | | | | | | | | 0.2 | | 0.8 |
| 177 | 69.68 | | | | | | | | | | | | 0.1 | |
| 179 | 70.47 | | | | | | | | | | | | | |
| No. of Girls. | | 1,260 | 3,618 | 4,913 | 5,289 | 5,132 | 4,827 | 4,507 | 4,187 | 3,411 | 2,537 | 1,656 | 1,171 | 790 |
| Corrected Mean Variation (cm.). | | 4.64 | 5.97 | 5.25 | 5.58 | 5.73 | 6.18 | 6.83 | 7.57 | 7.37 | 6.69 | 5.96 | 5.79 | 5.75 |

data on height in the six American cities—Boston, St. Louis, Milwaukee, Worcester, Toronto and Oakland. The figures in the body of the tables give the percentages of boys or girls at the ages (shown at the top of each column) who are of the heights indicated in the column at the left. An addition has been made in the original table of Dr. Boas by expressing the heights in inches as well as in centimeters. Each given height is meant to include two centimeters; thus in the first line the percentages are for the heights 91 cm. to 92.99 cm., the second line for the heights 93 to 94.99, and so on. Thus, for example, the column for boys of 5.589 years shows that .4 per cent. of the 1,535 boys between 5 and 6 years measure 35.83 to 36.61 inches in height, .6 per cent. measure 36.61 to 37.40 inches, and so on down to the smallest boys, .2 per cent. of whom measure 47.64 to 48.43 inches. These tables, therefore, give a ready reference for determining the variations of individuals.

TABLE D.

*Showing the Individual Yearly Height and Absolute Annual Increases of Dr. Wiener's Four Sons from Birth to 25 Years. (Centimeters.)*

| | First Born. | Second Born. | Third Born. | Fourth Born. Different Mother. | Annual Absolute Increase. | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | First Born. | Second Born. | Third Born. | Fourth Born. |
| Birth | 54.0 | 46.0 | 52.4 | 55.0 | | | | |
| 1 | 71.7 | 70.8 | 74.2 | 74.0 | 17.7 | 24.8 | 21.8 | 19.0 |
| 2 | 84.6 | 83.8 | 86.4 | 85.9 | 12.9 | 13.0 | 12.2 | 11.9 |
| 3 | 93.1 | 92.3 | 94.2 | 95.3 | 8.5 | 8.5 | 7.8 | 9.4 |
| 4 | 100.1 | 100.5 | 101.9 | 104.2 | 7.0 | 8.2 | 7.7 | 8.9 |
| 5 | 106.4 | 108.0 | 108.0 | 111.2 | 6.3 | 7.5 | 6.1 | 6.9 |
| 6 | 113.7 | 114.0 | 114.5 | 116.7 | 7.3 | 6.0 | 6.5 | 5.6 |
| 7 | 119.8 | 119.6 | 120.4 | 124.0 | 6.1 | 5.6 | 5.9 | 7.3 |
| 8 | 125.2 | 125.0 | 125.7 | 130.4 | 5.4 | 5.4 | 5.3 | 6.4 |
| 9 | 130.5 | 130.3 | 131.1 | 136.3 | 5.3 | 5.3 | 5.4 | 5.9 |
| 10 | 134.8 | 134.8 | 136.7 | 141.4 | 4.3 | 4.5 | 5.6 | 5.1 |
| 11 | 140.7 | 140.6 | 142.2 | 146.0 | 5.9 | 5.8 | 5.5 | 4.6 |
| 12 | 146.2 | 146.3 | 145.2 | 152.9 | 5.5 | 5.7 | 3.0 | 6.9 |
| 13 | 154.7 | 153.2 | 151.9 | 162.8 | 8.5 | 6.9 | 6.7 | 9.9 |
| 14 | 164.2 | 161.4 | 157.1 | 168.2 | 9.5 | 8.2 | 5.2 | 5.4 |
| 15 | 169.0 | 169.1 | 166.5 | 175.0 | 4.8 | 7.7 | 9.4 | 6.8 |
| 16 | 171.4 | 173.3 | 172.2 | 178.3 | 2.4 | 4.2 | 5.7 | 3.3 |
| 17 | 172.7 | 175.1 | 175.7 | 179.8 | 1.3 | 1.8 | 3.5 | 1.5 |
| 18 | 172.8 | 176.3 | 176.6 | 180.3 | 0.1 | 1.2 | 0.9 | 0.5 |
| 19 | 172.9 | 176.5 | 177.5 | 180.7 | 0.1 | 0.2 | 0.9 | 0.4 |
| 20 | 172.9 | 176.6 | 177.8 | 180.9 | 0.0 | 0.1 | 0.3 | 0.2 |
| 25 | 173.2 | 176.7 | 178.2 | | 0.3 | 0.02 | | |

As an interesting comparison with general averages computed from masses of children, the above table of the

growth in height of four individuals, from birth to manhood, are taken from a study by Dr. Christian Wiener of Karlsruhe.

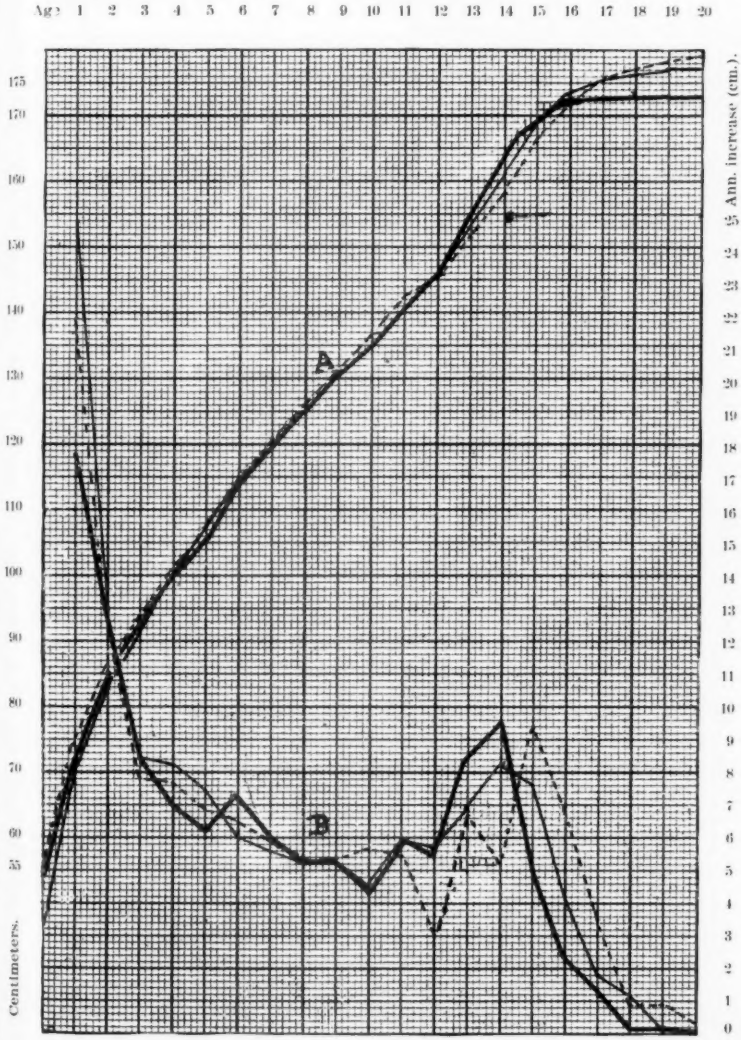
They are the measurements of the four sons of Dr. Wiener taken by himself.[1] The fourth-born son is by a different mother than the first three. The second wife was 5.1 centimeters taller than the first, and her child was born in her 36th year, while the first three sons were born in the 22d, 23d and 28th years respectively of their mother's life. The original measurements were taken not always exactly upon the birthdays, and the figures given, in order to make comparison available, have been computed to exact birthdays. The differences in time were generally so slight that the value of the figures is in no way affected.

The facts of these individual variations raise the important question whether or not the aim of training should be to make the child grow to specific dimensions. May it not be that each organism has ordained for it, we might say, by determined hereditary factors a particular size? This, however, is not the underlying principle of existing theories and practices in physical culture. The work of physical culture, as a rule, proceeds upon the assumption that there is an average size, and it should be our aim to approximate the average size or average proportion. In our gymnasiums our growing young people are measured. If the individual exceeds or falls short from the standard, specific exercises are given to develop this spot, to reduce that, and so forth. May, after all, this be all wrong? As will be later suggested by phenomena of growth, there is evidence that every organism seems to have a particular size, which it struggles desperately to attain. If we wish to speculate with Weismann, we may conceive that in the fertilized egg, the determinants have already, by hereditary forces, decided just the size and just the proportion each organism specifically ought to have. This decision is reached by natural selection within the egg. If in the growing period, by virtue of poor nutrition, disease, lack of exercise, or any other accident, any part of this organism fails to reach predetermined proportions, then there will be disharmony and lack of proper proportion. In so far will there be interference, for the parts will not exactly fit. Up to this point, we find ourselves in agreement with the ruling principle of physical development. But, upon the assumption of a particular size, is the physician or any one to determine by any tests of measurements what part should be developed or what reduced? The particular may vary from the "average" or the mean, and yet be entirely normal for that

[1]Other tables of individual growth, in weight as well as in height, will be found given by Camerer.(22)

CHART IV.

**Showing curves of growth (A) of Dr. Wiener's three oldest sons; also curves (B) of Absolute Annual Increases in inches taken from Table D. Heavy line in both A and B, eldest son; light line, second son; dotted line, third son. Figures are in centimeters; those on left apply to curves A, those on right to curves B.**



individual. By artificial development, may we not do for the individual just what disease or mal-nutrition is supposed to do—to destroy the particular proportion? This view is not put forth as a theory, but in the light of further treatment as an alternative view deserving consideration.

## Daily, Weekly and Seasonal Rhythms of Growth.

We have considered the increases in physical structure for the whole growing period, and have seen that the rate is by no means continuous and constant; but is broken up into a number of rhythms, as it were, rapid periods and then slower periods. It remains to consider the rate during a single year. Here, again, the view until very recent years has been the accepted notion that for this period, at least, the rate was constant. It was only a few years ago that Wretlind in Denmark weighed children before and after the three months' vacation, which occurred from July to September, and finding that the rate of increase during this period was more rapid than during the other nine months of the year, jumped to the conclusion that the injurious influence of attendance at school accounted for it. The chief contribution to this phase of the problem has been by R. Malling-Hansen, director of the Deaf and Dumb Institute at Copenhagen. He has weighed and measured his pupils, and in his three contributions on the subject has presented a mass of detailed information and some very suggestive causal theories. He finds three general seasonal periods during the year for height and the same number for weight; weekly variations, daily variations, and also a slighter rhythm, seemingly dependent upon the solar month.

The pupils of the school, 130 in number, were between the ages of 9 and 17. Nearly all of his tables in *Perioden im Gewicht der Kinder und in der Sonnenwärme*, are based upon measurements and weighings of about 70 boys, weighed from May, 1882, to February, 1886, and measured from February, 1884, to February, 1886; the children were weighed four times a day, with the exception of the vacation time from the middle of July to the end of August. The pupils were weighed in groups of sixteen to eighteen, and the heights given are similarly those of groups. His data therefore show nothing regarding individuals.

The most important of Malling-Hansen's contributions is that concerning seasonal growths. From his careful measurements of about 70 boys for two years, and weighings for three years, he concludes (†[64]): "The weight of a 9 to 15 year-old boy has three periods of growth during the year—a maximal, a middle, and a minimal. The maximal period begins

([64]) P. 29.

in August and concludes in the middle of December, lasting, therefore, four and one-half months. The middle period extends from the middle of December to the end of April, four and one-half months. The minimal period extends from the end of April to the end of July, therefore three months. During the maximal period the rate of increase in weight is three times as great as in the middle period. Almost the whole weight gained in the middle period is lost during the minimal period."

Respecting height he finds similar rhythms of growth, a maximal, a middle and a minimal period. "The minimal period begins in August and lasts until the middle of November, three and one-half months. The middle period reaches from the end of November till the end of March, about four months. The maximal period extends from the end of March until the middle of August, about four and one-half months. The daily rate of growth is two and one-half times as great, and that of the middle period twice as great, as that of the minimal period."

Approximately, it is to be observed, the period of maximal growth in weight, the autumn, is the period of minimal growth of height; and in spring and summer, while the body is growing most rapidly in height, it is actually losing in weight.

Malling-Hansen finds that children increase in weight and decrease in height by day, and increase in height and decrease in weight by night. In boys of 13 to 16 years, this increase or decrease can be as much as 10 millimeters, and a loss of .57 kilograms in weight during the night. The weekly variations are dependent upon local conditions, to a large extent due to variation or appetite.

Malling-Hansen has also given a body of facts and a very suggestive theory regarding the influence of temperature upon growth in weight and probably upon height. He finds that whenever there is an increase in atmospheric heat, there is also an increase in weight of the children weighed, and when the atmospheric temperature sinks, the rate of growth sinks. The correspondence is not, however, proportional in amount. At great labor and length, he gives tables of the temperature in various parts of the world for identical periods, and finds slight rhythms in the rise and fall of the atmospheric temperature; and thereupon offers as a cause an elaborate theory that the rotation of the sun upon its axis, thereby presenting different portions of its surface towards the earth, some of which radiate more heat than others, affects the growth in the animate world rhythmically. The periods are of about 25 or 26 days, within which are briefer periods of

maximal and minimal radiations of growth energy. He claims to show these effects, not only in growth of children, but in other physiological phenomena of adults, especially in women. His charts ([84]), explaining the theory, give details strikingly forcible in support of his theory.

Camerer* weighed a youth of 17 years, a boy of 8 years and an infant of six weeks several times during twenty-four hours, and also carefully weighed the food and excrement. He finds fluctuations in the youth of about one kilogram during the day; in the boy about .65 kilogram, and in the infant about .2 kilogram. The curves are strikingly alike in the three cases, rising in rhythms with slighter falling fluctuations from morning till evening; during the night the gain of the day is lost. Camerer corroborates Malling-Hansen also in the facts of the seasonal fluctuations, but declines to accept the meteorological explanation offered by the latter.

Dr. M. Vahl, of the school for homeless girls at Jagerpris in Denmark, weighed the pupils twice a year, on April 1 and October 1, from 1874 to 1883 inclusive. His results show that the increase in weight in the summer half year is about 33 per cent. greater than during the winter half year.

Vierordt (†[93]) offers some corroborative data in a table constructed from weights of children in first year, contributed by Fleischmann, Ahlfeld, Hesse, and Holmer. Distinct rhythms of growth in cycles approximating a week are shown. Fleischmann comments as follows: "If one weighs children weekly, he will be surprised at peculiar variations of increase. There is a period of rapid growth followed by a weaker period. This change is striking, and repeats itself weekly or half-weekly, so that in quite healthy children there is a continual fluctuation. What forces are operating are to me undiscoverable."

Combe in Lusanne studied the question whether or not the season of the year in which children are born affects their subsequent rates of growth. His tables follow the growth in height of children, segregated according to the month of the year in which they were born. He concludes that the rate (*i. e.*, determined by annual increments) is not affected, but that the height at any given age is very materially influenced. Boys born from September to February are shorter than those born from March to August; while in the case of girls, December to May inclusive are the unfavorable

* An earlier publication by this author, "*Der Stoffwechsel eines Kind in ersten Lebensjahre*" (*Zts. f. Biologie*, 1878) gives data on daily fluctuations more fully.

([84]) P. 247.

months for birth. The difference of the averages is slight, but nevertheless perceptible. This conclusion which Combe finds is interesting in connection with Malling-Hansen's principle of seasonal growths.

### Factors of Variation in Growth.

Some of the factors which have been put forth as influencing variations in growth, aside from those of age and sex, have been race, social and nutritional environment, occupation, climate, exercise and density of population. That some children are taller and heavier than other classes, either in the same or different localities, has been demonstrated; but exactly to what factors these variations are to be definitely attributed is a matter as yet far from conclusive solution. The problem in whatever form it occurs is always a highly complex one, making it difficult to segregate causes clearly.

*Nutrition.*—The view that growth in some degree is determined by nurturing environment is an old one, and existed before any careful and general statistics had been made. Villerme in 1829 concluded that stature is greater and the growth sooner completed, all other things being equal, in proportion as the country is richer and the comforts of the inhabitants more general. Quetelet later assumes and emphasizes this view and Cowell (†[26]) in England, from an investigation in 1833 of 1,062 factory children, and 228 others in more favored conditions, draws a similar conclusion. Boudin in France, from his studies of height and weight of different races, chiefly from military statistics, concluded that stature is to a great extent "independent of comfort and misery, and is on the contrary closely connected with race." Donaldson (†[29]), from the data in Roberts' Anthropometry, thinks that "the environment has more influence upon males than upon females." Porter (†[78]) in St. Louis is inclined to conclude that "a wide difference in social station and material prosperity may exist, without much influencing the growth up to the prepubertal acceleration," and Key (†[59]) goes so far as to say from comparison of curves of development in America, England and Sweden that "the weak period of development before puberty is lengthened for the poorer children to their cost. . . . The period of accelerated development is made later for them, but once commenced passes more quickly, and what is very surprising is completed generally in the same year as that of well-to-do children. The whole period is shorter for poor children, but there is a

([26]) Cowell's table will be found in Bowditch's "Growth of Children," p. 78.
([29]) P. 59. ([78]) P. 309. ([59]) P. 87.

stronger increase during the last year of the period." Roberts, from his comparison of data upon the favored and the artisan classes of England, says, "With the accession of puberty there is an increased rate of growth in the non-laboring classes, and an entire cessation of it at the age of 19 or 20 years; while in the artisan classes the growth is more uniform and extends to about the 23d year."

But such conclusions as these, upon a basis of actual measurements thus far made, are only valuable as suggestions. The conditions of actual data are yet far from absolutely justifying such sharply defined results.

General anthropometrical measurements upon adults with reference to the influences of race and nutrition have received important study by Drs. J. H. Baxter and B. A. Gould. Both find that American recruits are taller than those of European countries, and that natives of European countries who enlisted in American armies are taller than those who attained their growth in the lands of their nativity. Dr. Gould makes a forcible argument from statistics that this greater growth is attributable to the greater comfort of American life. Dr. Baxter, however, is inclined to minimize the influence of comfort and plenty.

In America the chief attempt to solve the problem of the influence of nutritional conditions upon growing children has been made by Dr. Bowditch of Boston. In the Eighth Annual Report, he deals with the problem more generally, but the Tenth Report is devoted chiefly to the factors of race and nutrition. In the Eighth Report, he gives a table of heights and weights of Boston boys attending certain schools, indicating the probability "that these pupils represent a class in

| Age. | Height (inches). | | Weight (lbs.). | |
|---|---|---|---|---|
| | Favored. | General. | Favored. | General. |
| 10 | 53.51 | 51.68 | 70.6 | 65.36 |
| 11 | 54.96 | 53.33 | 75.3 | 70.18 |
| 12 | 56.78 | 55.11 | 85.9 | 76.92 |
| 13 | 59.60 | 57.21 | 94.4 | 84.84 |
| 14 | 61.51 | 59.88 | 99.9 | 94.91 |
| 15 | 64.20 | 62.36 | 116.6 | 107.10 |
| 16 | 65.83 | 65.00 | 125.8 | 121.01 |
| 17 | 67.44 | 66.16 | 135.2 | 127.49 |
| 18 | 67.44 | 66.66 | 138.2 | 132.55 |

the community corresponding sufficiently well in social conditions to that class in England which sends children to the public schools and universities." This table is given above

under heading of "Favored." Compared with the entries in these columns are the entries from the general averages of the entire Boston school population. It is clear at a glance that, at any given age, the boys from the favored classes are both heavier and taller than those of the general school population.

Bowditch constructs a table and curve of heights in relation to weight, and concludes from English data of Roberts that it would seem that "deprivation of the comforts of life has a greater tendency to diminish stature than the weight of a growing child." Bowditch's general tables indicate that children in Boston of American parentage are both taller and heavier, at a given age, than children of foreign parentage. He draws attention to the fact that the foreign population comes, as a rule, from the poorer European classes, and he concludes: "It is reasonable to assume that the superior size of children of American parentage in the Boston schools is due in part to the greater comfort in which they live and grow up, and in part to other conditions, which may be described collectively as differences of race and stock."

In the Tenth Report, Dr. Bowditch groups, in tables and curves, the children by sex and ages from 5 to 18 years, into the rubrics of those whose parents are laboring, and those whose parents are non-laboring, and also takes the two races represented—American and Irish—and groups each of these separately into those whose parents are non-laboring and laboring. His tables show, on the whole, though differences are usually small, that the children of the poorer classes, at a given age, are smaller than those of the classes which enjoy presumably better nutrition, and Bowditch finds it "safe to conclude that the importance of mode of life as a factor in determining the size of growing children in this community (Boston) is at least equal to, and possibly even greater, than that of race."

One of the most general investigations bearing upon the effects of favorable and unfavorable influences is that of Roberts in England, detailed in his Anthropometry. He gives tables showing height, weight and chest girths of 7,709 males between the ages of 10 and 30 years, representing the most favored population of England—public school boys, military cadets, medical and university students. To be compared with these are tables showing the same facts from 13,931 males, between the ages of 4 and 50 years, belonging to the artisan class of England. Roberts concludes that the prepubertal growth begins in the favored classes a year or two earlier than in the laboring classes, and that there is "both a higher mean height and a wider range from tallest to shortest

among favored classes. . . . During the periods over which the observations extend, the most favored class has a mean height of about two inches greater than that of the industrial classes, but it is probable that if the observations were extended to the time of birth, they would gradually approximate." A second series of tables constitutes comparisons between boys and men from the professional, commercial, industrial classes, idiots and imbeciles, and Americans. The comparisons are generally in accord with those above indicated. The favored classes at any given age are very perceptibly heavier and taller on the average than those of the less favored classes.

The Anthropometric Committee of England, in its report ([37]) of 1883, presents data of height from 37,374 males and 1,616 females; and of weight from 33,043 males and 4,685 females of England, from birth to 70 years of age. By tables these data are segregated into four classes: professional, commercial, laboring (country), and town artisans. The data for the females when classified are of little value, owing to smallness of the numbers considered. The facts, however, generally indicate the conclusions that at any given age the professional classes are both taller and heavier than the less favored classes. Of special interest in this matter is a table of the growth in height and weight of 1,273 boys and 601 girls under 16 years of age, inmates of the Swinton Industrial School of England. They therefore represent the most unfavorable conditions of life and heredity. Compared with boys of Roberts' most favored class of England, these industrial school boys are, at 10 years of age, 3.31 inches shorter and 10.64 pounds lighter; at 14, 6.65 inches shorter and 21.85 pounds lighter.

Geissler and Uhlitsche compare the heights of children of the Freiburg Burgerschule with those of the children of the peasant classes in the surrounding country. The former live under relatively more favored conditions. For the ages given, the Burgerschule children are distinctively taller. The following table shows the differences in favor of the Burgerschule pupils at each age in centimeters:

| Age. | 6½ | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|
| Boys, | 2.4 | 2.7 | 2.3 | 5.1 | 2.7 | 2.3 | 3.8 | 4.7 |
| Girls, | 3.9 | 3.6 | 2.8 | 3.8 | 4.5 | 3.9 | 3.1 | 5.1 |

The compilers compare the heights of each class with the general average obtained, and feel justified in concluding, "The children of the peasant families are on the average, without exception, smaller and the children of the Burgerschule larger than the average of the whole. This fact stands

even when the corrections of probable error are applied. One may therefore perhaps assume that the different social conditions under which children live influence essentially their physical development."

Geissler in Gohlis-Leipzig separates the data of height and weight of children of a Burgerschule paying 18 marks from another paying 9 marks—a fact which the compiler considers basis for distinguishing the richer from the poorer classes. He does not give the tables, but summarizes his findings as follows: "The differences in height for boys of similar ages vary in favor of the richer class from 0.7 to 4.0 centimeters, and in weight between 7.3 and 4.7 pounds (German); with girls from 1.7 to 4.1 centimeters in height, and in weight between 1.6 and 4.6 pounds (German).

The Danish Commission ([51]) gave the subject of social and nutritive conditions some attention. Hertel ([52]) gives a table for boys and girls of 11, 12, 13 and 14 years. It shows that the boys of the Gymnasia, presumably representing the more favored classes, are slightly taller and heavier than the boys of the Real and Bürger schools, and the boys of the Real schools are taller and heavier as a rule than those of the Burger schools. These differences, varying up to an inch or two in height and to a pound in weight, are more distinct in earlier ages than at 14 years. In the Volkschulen, however, there is no essential difference between the boys who attend schools requiring tuition and those attending free schools, but the sons of the "Bauer" class (small country farmers) are taller and slightly heavier than the sons of "Arbeitern" (artisans). Among the girls of the ages as given, those in the higher girls' schools (the more favored class) are an inch, or less, taller; and heavier from no difference at 11 years to about 3 pounds at 14 years. In the girls of the Volksschulen, those who pay are heavier and taller (the difference increasing with age) than those who do not, and the daughters of the "Bauer" class have a slight advantage over the children of the "Arbeitern."

Erismann, quoting investigations of Michailoff upon comparisons of physical development of children in the city schools of Moscow, of village schools, and factory children, shows superiority in height of the Moscow boys in school over the factory boys as follows (in centimeters):

| Age, | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|
| Boys, | .4 | 4.6 | 5.7 | 5.7 | 7.7 | 9.0 | 9.7 | 8.7 | 5.4 |

But, strangely, the factory girl exceeds the school girl in height until the age of 14, but at this age and later falls very significantly behind. The height of the two classes is here given in centimeters.

| Age. | School Girls. | Factory Girls. |
|---|---|---|
| 7 | 111.6 | ..... |
| 8 | 116.4 | 118.8 |
| 9 | 119.6 | 123.6 |
| 10 | 125.0 | 129.5 |
| 11 | 129.7 | 131.0 |
| 12 | 132.9 | 135.5 |
| 13 | 138.3 | 139.9 |
| 14 | 145.8 | 143.4 |
| 15 | 146.4 | 148.2 |
| 16 | 150.3 | 151.0 |
| 17 | ..... | 152.4 |
| 18 | ..... | 152.8 |

The heights of factory boys at 8 years (based on less than 100 cases) are 2.3 centimeters greater than those of the school boys. The same general relation appears in the weights. Up to 11 years the school boys are shorter than the factory boys (the number of the latter is less than 100 for the years of 10 and 11) until 11 years, but after that age the school boys are taller by the following differences (in centimeters):

| Age, | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|
| Boys, | 1.12 | 2.21 | 6.06 | 5.79 | 6.70 | 8.5 | 7.8 | 5.4 |

The data for comparison of school girls with factory girls are not given; but city school girls, as well as boys, very significantly exceed village school girls and boys from 8 years through the 13th year (as far as data are given for the village children). In breast circumference the factory children, both boys and girls, slightly exceed the city school children at 8 to 12 years inclusive (data prior to 8 years not given), but after 12 years until 20 they are very slightly smaller.

Key ([58]) compares children attending the preparatory and middle schools of Stockholm with those of the Volksschulen, the former representing the more favored classes and the latter the poorer classes. The differences in favor of the better nourished children (indicated by the + sign) are given as follows (— indicates a difference in favor of the poorer classes):

HEIGHT.

| Age, | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|
| Boys (cm.), | +4 | +4 | +6 | +4 | +2 | +3 | +2 | +5 | +4 |
| Girls (cm.), | —1 | +2 | +2 | +2 | +3 | +3 | +2 | +2 | +3 |

WEIGHT.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Boys (kg.), | +0.3 | +0.4 | +3.0 | +1.6 | —1.4 | +1.5 | +1.6 | +5.3 | |
| Girls (kg.), | —0.6 | +1.8 | +1.4 | +1.4 | +1.4 | +2.0 | +1.9 | +3.5 | +2.9 |

Pagliani compares the weights of girls in a private school near Turin, Italy, with those of charity girls in the city. At 15 years the charity girls are 37.1 kilograms in weight and the school girls 45.6 kg. Stature also shows a difference against the charity girls.

The data as detailed seem clearly to justify the conclusion that, at any specified age (data are absent for ages under 6 or 7 years), children of both sexes, who live in conditions of more favorable nurture, are, on the average, both taller and heavier than those of less favored nutritional conditions. Our data upon this subject are extremely weak for ages under 10 years, and clearly many more numerous and more careful studies are needed before the principle involved will be cleared. But the question as to the *rate* of growth relatively in the favored and unfavored classes places our data under a new aspect. It is of importance to know at what period of growth favorable or unfavorable environment most affects growth as shown by the rate. It is evident that while the children in unfavored conditions may at any given age be actually smaller than those of the favored classes, yet they may make, nevertheless, a more rapid rate of growth. This will be clear by an example. Bowditch's girls of Irish parentage in Boston from the non-laboring classes are in height at 6 years 111.1 cm., while those of the laboring class average but 109.1 cm.; at 10 years the non-laboring class measures 131.7, the laboring 129.7; at 17 years the non-laboring are 156.2 cm., the laboring 155.7. The girls from the non-laboring classes exceed the girls from the laboring classes by 2 cm. at 6 years, 2 cm. at 10 years, .5 cm. at 17, and at every age, indeed, the table shows they are taller. Yet if we subtract the height of each class at 6 from the height at 10, we get in each case 20.6 cm., showing that for these four years the two classes made the same actual increment of growth. The apparent difference between them is due to the fact that at 6 years the girls from the laboring classes already were smaller. Now, if in the same way we subtract the height of each class at 10 years from their heights at 17, we find that in this period of seven years the non-laboring classes have grown 24.5 cm., while those of the laboring classes have grown 26 cm. In other words, while at each age the unfavored class is smaller, yet they have actually grown 1.5 cm. more than the favored class. Their rate has been more rapid. The differences at the different years is due to the fact that the unfavored class were smaller to begin with, that is, at 10 or 6 years. Reducing this rate to percentage form, we may say that the girls from the non-laboring classes grew 18.5 per cent. of their height at 6 years in the four ensuing years,

while those of the laboring class grew 18.8 of their average height at 6. From 10 to 17 years the favored class grew 18.6 per cent. of their height at 10 years, and the unfavored class grew 20 per cent. of their height at 10. Did all data bear out this ratio, we should conclude that children under poor nutritive conditions grow faster from 6 to 17 years than children from the favored class, and that the conditions which poor nutrition affect must lie in the early years of childhood or embryonic life. Indeed, on the whole, the data will point to a possible conclusion of this kind. If, now, we take the same data that have been reviewed and calculate the percentage rate of growth, we are not able to conclude so definitely that the child of favorable conditions always grows faster than the child of unfavorable conditions. There seems to be very little difference in the two rates on a whole, and the children of the unfavored classes in height exceed those of the favored classes in percentage rate more than the reverse. In weight increases, however, the coincidence is pretty clear that poor nutrition steadily lessens the rate of growth. As a rule the results are based upon such small numbers that the figures are not of assuring value. We may take Bowditch's figures from the Tenth Report for an illustration, and the following tables are calculated from the different classes represented, both as to height and weight:

TABLE J.

*Showing the Rates of Growth of Favored and Unfavored Classes, Calculated from Bowditch of Boston.*

| BOYS OF BOSTON. | Height at 6 years. cm. | Height at 10 Years. cm. | Height at 17 Years. cm. | Absolute Increase. 6-10 Yrs. cm. | Absolute Increase. 10-17 Yrs. cm. | Per Cent. Increase. 6-10 Yrs. | Per Cent. Increase. 10-17 Yrs. |
|---|---|---|---|---|---|---|---|
| American— | | | | | | | |
| Non-laboring Class, | 113.0 | 133.0 | 168.7 | 20.0 | 35.7 | 17.6 | 26.8 |
| Laboring Class, | 111.5 | 132.0 | 167.6 | 20.5 | 35.6 | 18.4 | 26.9 |
| Irish— | | | | | | | |
| Non-laboring Class, | 110.8 | 131.5 | 165.1 | 20.7 | 33.6 | 18.7 | 25.5 |
| Laboring Class, | 111.2 | 131.0 | 168.5 | 19.8 | 37.5 | 17.8 | 28.6 |
| Irrespective of Nationality — Non-laboring, | 112.1 | 132.5 | 168.1 | 20.4 | 35.6 | 18.2 | 24.6 |
| Laboring, | 111.2 | 131.0 | 167.1 | 19.8 | 36.1 | 17.8 | 27.5 |

| Girls of Boston. | Height at 6 Years. cm. | Height at 10 Years. cm. | Height at 17 Years. cm. | Absolute Increase. 6-10 Yrs. cm. | Absolute Increase. 10-17 Yrs. cm. | Per Cent. Increase. 6-10 Yrs. | Per Cent. Increase. 10-17 Yrs. |
|---|---|---|---|---|---|---|---|
| American— | | | | | | | |
| Non-laboring Class, | 113.4 | 131.8 | 157.6 | 18.4 | 25.8 | 16.2 | 19.6 |
| Laboring Class, | 110.4 | 131.5 | 157.5 | 21.1 | 26.0 | 19.2 | 19.8 |
| Irish— | | | | | | | |
| Non-laboring Class, | 111.1 | 131.7 | 156.2 | 20.6 | 24.5 | 18.5 | 18.6 |
| Laboring Class, | 109.9 | 129.7 | 155.7 | 19.8 | 26.0 | 18.0 | 20.0 |
| Irrespective of Nationality—Non-laboring, | 112.1 | 131.3 | 157.3 | 19.1 | 26.0 | 17.0 | 19.8 |
| Laboring, | 109.9 | 130.3 | 157.4 | 20.4 | 27.1 | 18.5 | 20.8 |

| Boys of Boston. | Weight at 6 Years. lbs. | Weight at 10 Years. lbs. | Weight at 17 Years. lbs. | Absolute Increase. 6-10 Yrs. lbs. | Absolute Increase. 10-17 Yrs. lbs. | Per Cent. Increase. 6-10 Yrs. | Per Cent. Increase. 10-17 Yrs. |
|---|---|---|---|---|---|---|---|
| American— | | | | | | | |
| Non-laboring Class, | 45.61 | 66.05 | 129.2 | 20.44 | 63.15 | 44.8 | 95.6 |
| Laboring Class, | 44.81 | 66.38 | 128.6 | 21.57 | 62.22 | 48.1 | 93.8 |
| Irish— | | | | | | | |
| Non-laboring Class, | 45.33 | 67.37 | 119.15 | 22.04 | 51.78 | 48.7 | 76.9 |
| Laboring Class, | 45.25 | 64.70 | 124.5 | 19.45 | 59.85 | 42.9 | 92.5 |
| Irrespective of Nationality—Non-laboring, | 45.50 | 65.31 | 128.23 | 19.81 | 62.92 | 43.5 | 96.3 |
| Laboring, | 45.06 | 64.89 | 125.28 | 19.83 | 60.40 | 43.9 | 93.0 |
| Girls of Boston. | | | | | | | |
| American— | | | | | | | |
| Non-laboring Class, | 44.43 | 64.78 | 116.3 | 20.35 | 51.52 | 45.8 | 79.5 |
| Laboring Class, | 43.47 | 63.47 | 115.14 | 20.00 | 51.67 | 46.0 | 81.4 |
| Irish— | | | | | | | |
| Non-laboring Class, | 44.05 | 63.64 | 110.75 | 19.59 | 47.11 | 44.5 | 74.7 |
| Laboring Class, | 43.15 | 61.35 | 121.8 | 18.20 | 60.45 | 42.2 | 98.5 |
| Irrespective of Nationality—Non-laboring, | 44.14 | 63.76 | 115.15 | 19.62 | 51.39 | 44.4 | 80.6 |
| Laboring, | 43.13 | 61.98 | 115.72 | 18.85 | 53.74 | 43.7 | 86.7 |

It is evident that the data give no certain evidence of an increase in rate with better nutrition, though at any given age there is a difference. In the majority of cases, where there is any material difference in rate indicated, the children of poorer nutrition grow faster.

Roberts' comparison between the favored and unfavored classes of England at any given age indicate very significant differences to the advantage of the former. At 10 years, the average of the favored classes is 2.88 inches taller, 1.09 pounds heavier, and 3.61 inches greater in chest girth. At 17 the average of the favored class is 3.39 inches taller, 31.6 pounds heavier, and 4.60 inches greater in chest girth. Yet if we take into consideration the actual sizes of both classes at 10 years, the increases except for weight are not significantly greater. Thus:

| | Height Increase. 10-17 Years. | Chest Increase (empty). 10-17 Years. | Weight Increase. 10-17 Years. |
|---|---|---|---|
| Favored, | 14.4 | 5.4 | 80.6 |
| Artisan, | 14.2 | 4.5 | 50.1 |

From Key's tables, instituting a comparison between the favored classes in the middle and preparatory schools and the poorer classes in the Volkschulen, the data show the amount of growth for the two periods as follows:

| | Height. | | Weight. | |
|---|---|---|---|---|
| | 6-10 Years. | 10-17 Years. | 6-10 Years. | 10-17 Years. |
| Boys— | | | | |
| Favored, | 12 cm. | 23 cm. | 7.5 kg. | 22.0 kg. |
| Poor, | 12 | 23 | 6.2 | 15.6 |
| Girls— | | | | |
| Favored, | 16 | 25 | 7.8 | 19.5 |
| Poor, | 13 | 24 | 7.8 | 18.0 |

The writer has similarly calculated the percentages of growth from 6 to 10, and 10 to a later age, as made possible by the data upon favored and unfavored classes, offered by the Anthropological Commission, Geissler and Uhlitzsch in Freiburg, Erismann in Moscow, and Hertel in Denmark. The results are by no means conclusive. In weight the evidence is stronger that poor nutrition retards the rate of growth, but the conflict of results suggests that factors other than those of nutrition enter, and that data must be first obtained free from such complications before the problem can be definitely solved. Perhaps the safer form of conclusion is that from ages 6 to 17 the rate of growth is not so distinctly affected by differences in nutrition as the actual divergence of size at any given age would suggest, and that of rates of increase in height and weight, the latter seems more susceptible of retardation due to this cause.

Porter ([78]) expresses a suggestive and important theory, if true, that differences due to social conditions have slight effect before the prepubertal acceleration.

Porter compared the weight of 2,000 girls, separated into the classes, daughters of professional men and merchants (655), and the daughters of artisans and laborers (1,345), of St. Louis. During the 7th and 8th years, the daughters of the artisans and laborers were heavier by .42 and .11 kilograms respectively, but at 8 years the daughters of the professional and mercantile classes gain the slight ascendency and maintain it by the following differences in kilograms:

| Age. | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|
| | .11 | .37 | .15 | 1.18 | 1.58 | 1.97 | 2.09 | 1.87 | .98 | 2.51 |

Porter's conclusion is not clearly supported by comparisons from other investigations. Though valuable as a tentative suggestion, it is as yet, in the condition of facts, premature.

*Influence of different food stuffs:* The influence of different foods upon growth has been submitted to an accurate experimental test by Malling-Hansen in a Deaf and Dumb Asylum of Copenhagen. It was, in fact, the purpose of the elaborate system of weighings, previously described, to determine the influence of various foods. On May 16, 1883, a change of diet at the asylum went into effect. The previous diet consisted largely of black bread and beer. The new substituted white bread and milk, and in other details made it considerably richer in albuminous food. Malling-Hansen compares the growth in weight under the two diets, for eight months, from September 11, 1882, to May 11, 1883, with the beer and black bread; and from September 11, 1883, to May 11, 1884, with white bread and milk. The 70 boys, in the aggregate, increased 105 pounds more under the new diet than under the old. But, Malling-Hansen points out, this increase was not distributed evenly over the eight months from May to December. On the contrary the curves of increase for the two years, under radically different foods, ran practically parallel for the six months and a half from November 22 to May 11. The whole increase took place in the month and a half from October 11th to November 22d. In the case of the girls the difference of increase, under the two forms of diet, was 76 pounds, and all this was gained in 32 days. As a conclusion Malling-Hansen is inclined to discredit any direct material influence of different foods upon growth, and to ascribe all direct causes of acceleration to internal forces.

Dr. C. Voit of Bavaria, in a brief monograph, enters a forcible criticism to Malling-Hansen's conclusion that difference in foods has nothing or very little to do with growth. He contends that weight is no true index of the essential pro-

cesses of growth. Increase in weight may be due (and he offers facts in proof) simply to greater absorption of water by the body, or by mere addition of fat. Only an exact chemical analysis could reveal the effects of the change in diet described by Malling-Hansen. The children may have been making essential increases in growth which the scales under certain circumstances would not reveal.

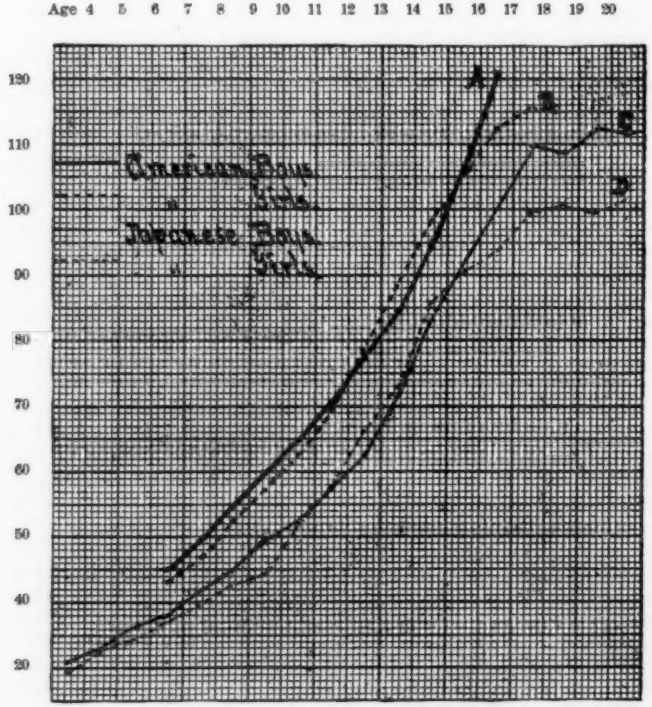
Boas ([13]) quotes Cartier as proving that children of unfavorable nutritional environment brought under favorable condition grow more rapidly than the rest, who are left in their former conditions.

The effect of different foods upon infants has been investigated by Russow ([84]) in Oldenburg Hospital. Some infants were nourished exclusively at the breast and others were given a mixed diet. At 15 days the average of the first class was 3,564 grammes and the last class 3,525 grammes. At the end of this year the infants nourished exclusively at the breast weighed on the average 9,930 grammes, and those on a mixed diet 8,480 grammes, showing a difference of weight of 1,450 grammes. The breast-nourished infants increased 150.7% of their weight at 15 days, and those of the mixed diet 140.7%, which is not a difference of striking suggestion in favor of the effects of superior nourishment. More conclusive is the evidence furnished by Camerer ([23]). Fifty-seven infants, all weighing over 2,750 grammes and averaging 3,450 grammes at birth, were fed at the breasts of mothers or nurses, and at the end of the first year averaged 9,889 grammes; on the other hand 31 infants, all weighing more than 2,750 grammes and averaging 3,221 grammes at birth, were nourished by artificial preparations, and at the end of the year averaged 9,954 grammes; the latter were, therefore, slightly lighter at birth and heavier at the end of the year. The curves of growth given by Camerer show in the middle of the year the breast-fed children were heavier, but he concludes that whatever the nourishment during the first year, nevertheless all children at the end of the year reach about the same weight. Of course, he means to except children who are very materially lighter at birth, for whom he gives separate tables. Eighteen cases of infants averaging 2,390 grammes at birth, fed upon a mixed diet of breast milk and artificial preparations, weigh on the average at the end of the year but 8,490 grammes, and 10 others averaging 1,630 grammes at birth, under a similar diet, reach 6,610 grammes at the end of the year. Camerer gives about fifty individual cases, tabulating weights by weeks, and there is no evidence of the effects of differences of food, judging from the compared results at the end of the first year. If anything, results favor artificial food.

*Influences of Race:* It is the general conviction of students of anthropometry that race, as a factor in determining growth, is one of significant if not of first importance. But the consideration of this problem leads further into the realms of pure anthropometry than a pedagogical study would justify.* There is little material in the investigations of growing children that sheds conclusive proof. In a general way, by com-

CHART V.

Comparing curves of growth in weight of average American boy and girl (taken from Table I) and of average Japanese boy and girl (taken from data of Dr. Miwa). Figures on left are in pounds.




*The Lowell Lectures by Professor W. Z. Ripley, published in the *Popular Science Monthy* during 1897, are particularly illuminating on this subject.

parisons of investigations of growth in different countries, given in the tables, it will be seen that at a given age American children are, as a rule, taller than European children, and that in Europe the Italians and Belgians are shortest Baxter and Gould, as already stated, have drawn important conclusions for growth under American conditions. Bowditch ([19]) gives the most comprehensive treatment relative to growing children, and inclines to the recognition of racial influences of considerable importance. Peckham follows the general plan of Bowditch's investigation, and finds that Milwaukee children of American parentage are about half an inch taller than children of German parentage. His tables would indicate that these racial differences are more pronounced after the tenth year, beginning with the prepubertal acceleration. Peckham can reach no conclusion regarding the influence of race upon weight. Porter, in St. Louis, finds no traces justifying a conclusion of considerable influence of race as a factor. Landsberger deals with the subject somewhat, finding up to the 10th year at least no appreciable differences between children of German parentage and Polish children. He criticises Bowditch's conclusions recognizing racial influence upon the children of Boston. The Report of the Anthropometrical Committee in England ([37]) gives considerable data, tables and charts indicating differences in size of the people in various parts of Great Britain and Ireland.

Bowditch reviews the statistics of Erismann in Russia and Pagliani in Italy, and concludes that Italian children are in early life very much smaller than American children; although they make a gain later, they never overtake Americans. The Russian factory children also are smaller throughout, but these children, of course, as Bowditch states, do not represent the typical Russian growth.

*Climate:* Climate as a separate factor exerting a direct influence upon growth in height and weight, has received comparatively little attention upon a statistical basis. Peckham briefly reviews the facts, and concludes "that climate has any considerable effect in modifying growth seems quite improbable. Theoretically, a low temperature ought to stunt men, since a large amount of energy would be expended in maintaining the bodily heat; and the further strain upon the digestive system to provide the large quantity of food necessary for this purpose would leave a smaller surplus for growth. The evidence, however, so far as we can disentangle it, does not justify this inference. Taking a wide survey of the facts, we find that the Western Esquimaux, the negroes of Guinea, the Australians, the Patagonians, the Kaffirs, all have an average height of over 170 centimeters. In Europe the non-

dependence of stature upon latitude is patent. For South America, D'Orbigny discarded the theory most emphatically. Dr. Baxter's table showing the order of superiority, by states, of American-born white men, is a remarkable series of observations for refuting the supposition."

The Anthropometric Committee's Report ([37]) of stature in different parts of Great Britain and Ireland deals extensively with this feature, and certainly shows significant variations with localities, but to conclude that climate is the determining factor is merely, of course, an hypothesis. Dr. Beddoe ([†4]), speaking of this fact, says: "The idea that climate, *per se*, has any influence upon stature is very little supported by our materials. At the first blush, we might be disposed to think that a northern position and a somewhat vigorous climate operated favorably probably by natural selection. Climate, where it does influence the growth of men, probably does so, either through natural selection or by affecting his food and mode of life." In America, the growth of children in various cities, as cited, shows different degrees; but these objections, of course, hold against concluding that climate is the determining condition. Peckham, for example, explains the larger growth of Milwaukee children over Boston children upon a theory of a greater density of population in the latter city. Dr. Gould and Dr. Baxter, already cited, deal with the problem, in its adult relations for America, and their results would support the view of the influence of climate. The climate has generally been supposed to regulate the time of pubertal acceleration and this, as Key ([†59]) points out, is earlier by a year in Italy and America than in Sweden.

Bowditch ([21]), reviewing Baxter's and Gould's results, concludes that the fact that natives of the Eastern States emigrating in childhood to Western States resemble the natives of the states to which they emigrate, justifies serious inquiry into climatic influences.

The subject of climatic influences as a factor of variation in growth may therefore be taken as yet undetermined, though it hardly seems possible that, at least in some indirect way, it is not important.

## Growth in Relation to Susceptibility to Disease.

There seems to be evidence that children are able to resist diseases at certain ages better than at other ages. This conclusion is based upon studies in the death rates of children

([4]) P. 173.
([59]) P. 79.

and by studies of the prevalence of diseases at different ages of children, undertaken chiefly in Sweden and Denmark. In the report of Dr. E. M. Hartwell, director of physical training in the Boston public schools (1894), is found the conclusion that the period of pubertal change, approximately the five years between the 11th and 16th years, is the period of lowest death rate. The basis for Dr. Hartwell's conclusion rests upon the census returns of Boston for 1875, 1885 and 1890. The rate of deaths per 1000 inhabitants for these three census years together is as follows:

TABLE K.

*Showing Children's Death Rate in Boston (Hartwell).*

| AGES. | F. | M. |
|---|---|---|
| 0-1 | 256.24 | 299.51 |
| 1-2 | 117.58 | 137.98 |
| 2-3 | 37.01 | 38.14 |
| 3-4 | 24.80 | 26.51 |
| 4-5 | 21.55 | 20.73 |
| 5-6 | 16.44 | 14.85 |
| 6-7 | 14.38 | 13.40 |
| 7-8 | 9.62 | 9.35 |
| 8-9 | 8.11 | 6.09 |
| 9-10 | 5.11 | 7.41 |
| 10-11 | 5.23 | 4.77 |
| 11-12 | 3.23 | 4.28 |
| 12-13 | 4.30 | 3.44 |
| 13-14 | 6.17 | 4.18 |
| 14-15 | 5.83 | 3.98 |
| 15-16 | 5.89 | 5.31 |
| 16-17 | 6.57 | 6.58 |
| 17-18 | 7.94 | 6.43 |
| 18-19 | 6.32 | 10.40 |
| 19-20 | 10.48 | 10.25 |
| 20-21 | 6.95 | 11.21 |

The death rate steadily decreases from birth until the 13th year. The decrease from 5 to 12 years is at a slower rate than for the first five years. These figures, of course, do not argue necessarily that all children are more susceptible to attack in the earlier ages, for it must be remembered that the large numbers who die in infancy remove the children more susceptible to sickness. In the percentages for boys, it will be observed that there is a slight rise in the 10th year.

The year of minium death rate is not always the same, Dr. Hartwell points out. It was the 12th year for girls during 1875 and 1885, but the 13th for 1890; in the case of boys, the minimum year was the 13th in 1875, the 14th in 1885, and

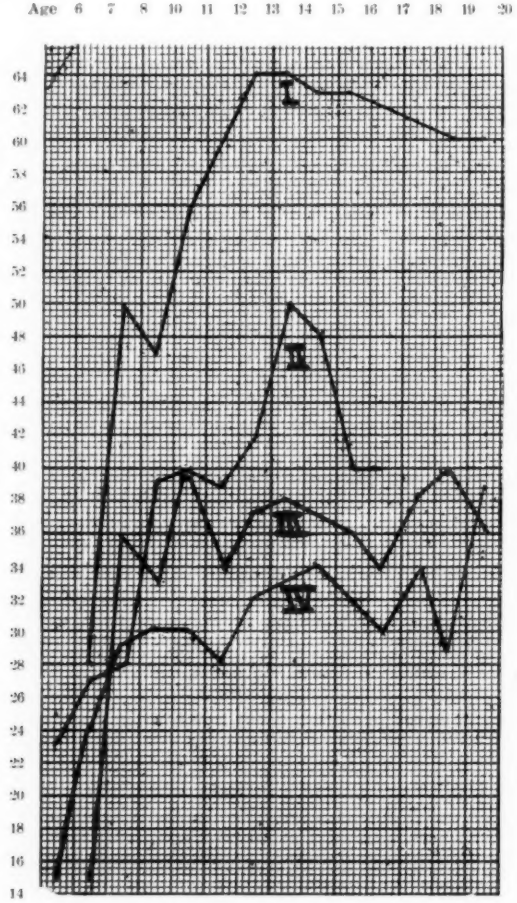
the 15th in 1890. It will be safer, therefore, in considering these figures, to regard the whole pubertal period as one, in a general sense, of strong vitality. The year of strongest vitality for boys is, we see, one year later than that of girls, following, therefore, the periods of development in the sexes. Dr. Hartwell cites Dr. William Farr as calling attention many years ago to the fact that the death rates of England fell to their lowest point in the period 10-15 years of age, during which puberty is established, and rose thereafter. "That the period 10-15 is the half decade in all human life," Dr. Hartwell concludes, "in which the fewest deaths occur to a thousand living, is illustrated in the vital statistics of all civilized countries."

The chief studies bearing upon diseases in the growing ages are those of the Danish ([57]) and Swedish ([58]) Commission; the Report of the Committee on Mental and Physical Condition of Children in England ([109]), Combe of Lausanne, Hertel ([52]) in Denmark, and Schmidt-Monnard of Halle. The results of the Danish and Swedish Commissions are so similar in many respects that they can conveniently be reviewed together. In Denmark, in 1883, the Danish Commission examined 17,595 boys and 11,646 girls in the higher schools and Volksschulen, 6 to 19 years of age. The information was obtained from teachers, parents, official school physicians and family physicians. The diseases reported are chiefly the distinctly chronic diseases: the acute complaints were excluded. The chief diseases are scrofula, anæmia, nervous complaints, headache, nose-bleed, chronic indigestion, chronic lung and heart complaints, curvature of the spine, and other chronic diseases such as kidney complaints, rheumatism, etc. Shortsightedness is treated separately, and the figures concerning this disease are not included in the present discussion.

The Swedish Commission undertook its work about the same time. The diseases investigated were practically the same. The Swedish Commission, however, dealt with a larger number of pupils in the higher schools and preparatory schools, but excluded data from the Volksschulen. The results are, therefore, not exactly comparable. Diagrams express graphically the prevalence of chronic diseases at different ages, and it is seen at a glance that the form of the curves is singularly alike in both investigations. About 14 to 16 per cent. of the boys at six years of age are afflicted with some chronic disease. The curve rises with abrupt rapidity, until the latter part of the ninth year, when the Swedish curve shows a sudden sinking of 4 per cent., and again rapidly rises in the 11th year. The rate of Danish curve slackens and shows a stationary tendency until the 11th

CHART VII.

**Showing per cent of chronic diseases in Sweden and Denmark (adapted from Hertel). I, higher girls' schools of Sweden; II, higher girls' schools of Denmark; III, gymnasia and preparatory schools (boys) of Sweden; IV, approximately comparable schools (to III) of Denmark. Figures on left represent the per cent. of children affected.**



year. During the 11th year both curves have reached a crisis. Both fall to their lowest point in the 12th year, the healthiest in the pubertal period. There is then a gradual rise in each, reaching a second summit, in Sweden, in the 14th year and in Denmark in the 15th year, and both sink in the 17th year, the close of the period of rapid growth, to rise abruptly in the 18th and 19th years. Hertel's own investigation ([52]), undertaken in 1881 upon 3,141 boys and 1,211 girls in the higher schools of Copenhagen, practically agrees in form with the foregoing in essential fluctuations.

The disease curves for girls show the same agreement in form in the two investigations, though, as in the case of boys, disease is proportionately more prevalent in Sweden than in Denmark. At 6 years, from 22 to 25 per cent. of the girls are afflicted with chronic complaints, and the curve rises gradually until the 14th year and then sinks, rapidly and considerably in Denmark, and but slightly in Sweden. Two fluctuations are to be observed, one in the 9th year in Denmark, and from the middle of the 9th to the 10th in Sweden; a second, more distinct in Sweden from the 11th to the 12th year. It would seem at these periods there is a slight improvement in health of the girls.

Combe of Lausanne gives data more upon the individual plan. His observations are upon about 2,000 school children, covering a period of 6 years. Combe's figures give data only from the 9th to the 15th years. His data include some of the infectious as well as chronic diseases, and, therefore, are not comparable to those of the Danish and Swedish Commissions. In the 9th year 64 per cent. of the boys are afflicted, but the curve abruptly sinks to 29 per cent. in the 14th year, just before the year of most rapid growth in height (43 in 10th year, 42 in 11th, 40 in 12th, 33 in 13th); from 29 per cent. in the 14th year the disease curve rises to 34 per cent. in the 15th. With girls there is a percentage of 88 per cent. in the 9th year; it falls to 75 per cent. in the 10th and 60 per cent. in 11th, but with increase in rapidity of growth, rises to 66 per cent. in 12th and 68 per cent. in 13th; then sinks to 61 per cent. in 14th, and 39 per cent. in 15th year.

Schmidt-Monnard's study upon several thousand pupils in the higher and middle schools of Halle, is approached largely from the assumption that the schools are responsible for sickness, and his effort is chiefly to trace this causal relation. However, his data show whether the causes be in the schools wholly or partly in organic conditions of growth, that there is from 5 to 10 per cent. less sickness among boys than girls at all ages; that the amount of sickness varies with kind of schools, social condition of pupils, and grade (or age). Averaging his results he finds that the sickness curve steadily

rises until the 13th or 14th year in both sexes, and then falls from 30 to about 18 per cent. with boys, and from 30 to 40 per cent. in the case of girls, to 27 per cent. His data do not give information beyond the 15th year. Among the conclusions of the author are the following: Acute diseases occur principally in the primary school years, and in general are more frequent and persistent in children of unfavorable nutritional conditions than among the favored classes—among Bürger school children less than among the Volksschulen; chronic diseases increase during the school year and are especially induced in schools having an afternoon session, or children burdened by outside duties such as music, housework, etc.; in the 13th or 14th year there is nominally a decrease in the percentage of disease.

The Report of the British Committee on Mental and Physical Condition of Children ([109]), embracing the results of Dr. Francis Warner's investigation and covering the data of 100,000 English children, is not classified in form and matter in a way that permits comparison with the foregoing studies.

This report, together with Dr. Francis Warner's publications, furnishes information and suggestions which no one responsible for the care of children can afford to be without. The report deals chiefly with: (1) defects of development of the body and its parts in size, form, or proportion of parts; (2) certain abnormal actions, movements and balances due to nervous abnormalities or disturbances; (3) low nutrition; (4) mental dullness. All of these publications are readily available in English. The report is published by the Committee, Parker Museum, Margaret street, London, W. (1895). Dr. Warner's original report of 50,000 children (which comprises half the present report) is reprinted in the Report of the Commissioner of Education (U. S.), Vol. II, for the year 1890-91.

*Growth and Resistance to Disease:* There has been an attempt to connect the periods of rapid growth with those of power to resist disease. The figures upon death rates, as Dr. Hartwell concludes, certainly point to this conclusion. Dr. Hartwell in support of his position gives the following table, comparing the rate of growth in both height and weight with what he terms "specific life intensity;" by this he means the ratio of the number dying at a given age to the number living at that age. When this ratio is high, a high power of resistance to disease is indicated, and *vice versa*.

Axel Key of the Swedish Commission agrees with Dr. Hartwell in linking better resistance to disease with accelerated growth, and the susceptibility to disease with the periods of slow growth. "The curve of disease (in boys)," he ob-

## Chart VI.

**Comparing specific life intensity with rate of growth in height and weight for Boston children. Curves I (boys) and II (girls) show specific life intensity (taken from Table L); curves III and IV and curves V and VI represent respectively the percentage annual increases in weight and height as given in Tables G and C. Continuous line represents boys, and dotted line girls. Figures on left apply to curves I and II; figures on right to III, IV, V and VI.**

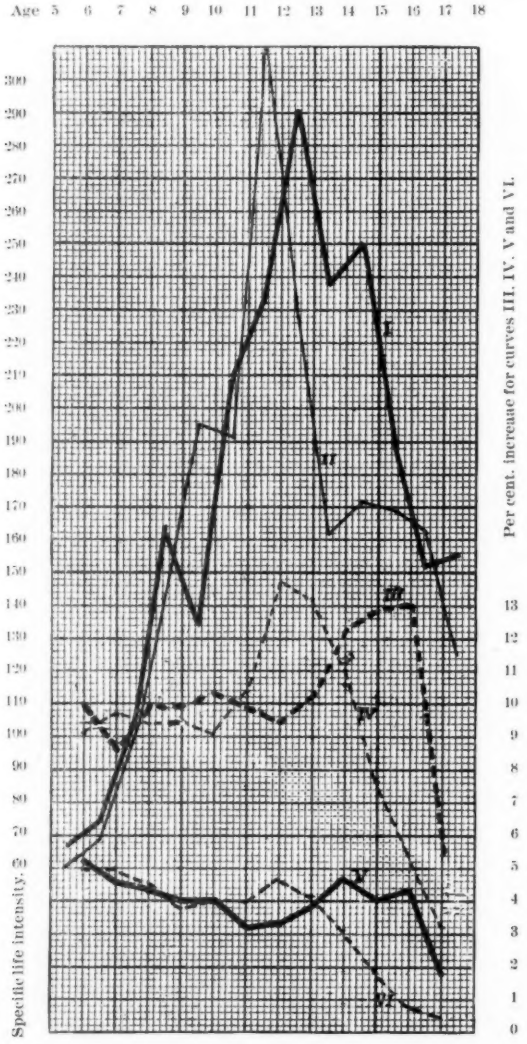


TABLE L.

*Showing Specific Life Intensity of Boston Children at Different Ages (Hartwell).*

**(The figures in heavy-faced type indicate the pubertal years.)**

| AGE. | Per Cent. Increase. Height. | | Specific Life Intensity. | | Per Cent. Increase. Weight. | |
|---|---|---|---|---|---|---|
| | Girls. | Boys. | Girls. | Boys. | Girls. | Boys. |
| 5— 6 | 4.00 | 5.20 | 60.08 | 67.3 | 8.88 | 10.24 |
| 6— 7 | 4.08 | 4.58 | 69.5 | 74.5 | 9.69 | 8.78 |
| 7— 8 | 4.58 | 4.38 | 103.8 | 106.8 | 8.83 | 9.86 |
| 8— 9 | 3.72 | 4.03 | 123.2 | 164.0 | 10.68 | 9.79 |
| 9—10 | 3.98 | 4.04 | 195.4 | 134.8 | 9.26 | 10.40 |
| 10—11 | 4.06 | 3.12 | 191.2 | 209.3 | 10.24 | 7.43 |
| 11—12 | 4.56 | 3.39 | 309.0 | 233.2 | 13.78 | 9.74 |
| 12—13 | 4.08 | 3.78 | 232.0 | 290.1 | 13.23 | 10.31 |
| 13—14 | 3.11 | 4.68 | 162.0 | 236.7 | 10.94 | 11.66 |
| 14—15 | 1.90 | 4.01 | 171.3 | 250.1 | 7.83 | 13.02 |
| 15—16 | .77 | 4.36 | 169.3 | 188.1 | 5.61 | 12.96 |
| 16—17 | .51 | 1.75 | 152.0 | 151.9 | 3.14 | 5.23 |
| 17—18 | .... | .77 | 125.6 | 155.3 | .... | 3.97 |

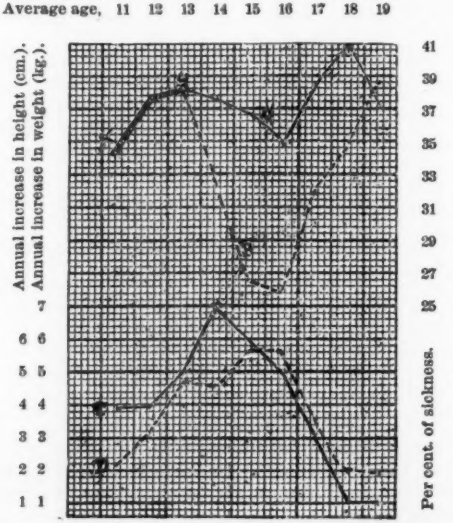
serves, "reaches its first summit directly before, or, more correctly, at the beginning of the pubertal development. But as soon as this development sets in forcibly, the curve sinks year by year, so long as that accelerated growth continues. The curve is lowest the two last years of the pubertal period, just when the increase in weight is greatest. Directly at the conclusion of the pubertal period, when the yearly increases in height and weight hastily decrease, the curve of disease, on the other hand, jumps to its second summit, which it reaches in the 18th or 19th year (†[58]). The year of strongest health is, therefore, the 17th. For no year is the height of the curve of disease so great as for the 18th, and next to it is the 13th. On the other hand, regarding the period of slow growth from the 8th to the 12th year, Key con-

([58]) P. 250.

cludes, "All facts point unquestionably to the conclusion that the period of slow development preceding puberty is a period during which the power of resisting injurious external influences is weak, and the percentage of sickness increases, particularly in the years immediately prior to the pubertal

CHART VIII.

Percentage of chronic disease in Swedish boys' schools in comparison with rate of growth (after Key). Curve x-y, sickness in Volks classes; curve A, sickness in Latin classes; curve B, sickness in Real classes; curve C, annual increase in weight (kilograms); curve D, annual increase in height (centimeters). Figures on right represent percentage of pupils affected by disease.




development." In the case of girls, Key finds that the relation of rapid growth and decrease of sickness does not appear so sharply defined as in the case of boys. He says, "With the development of girls throughout, the curve of sickness reaches its first summit in the second pubertal year (the 13th), which is the year of accelerated increase in weight, and sinks thereafter very little, and rises not directly after the conclusion of pubertal growth, but in reality two years later (in the 18th). We see, therefore, that the last year of puberty must be recognized as the weaker in resistance than the one which directly follows the close of the period."

Hertel ([53]) in Denmark, in his discussion of his own investigation and that of the Danish Commission, seeks to find the causes of fluctuations of the percentage of disease in various years in local conditions of the school and the home, rather than in any organic relation to the growth processes. He says, however, of the period of three or four years prior to the pubertal change, "It would appear that this change is preceded by a short period of greater delicacy than usual, with greater susceptibility to unfavorable external influences" (†[52]). "The maximum percentage of disease," he says, "is reached in the 12th or 13th year, directly at the threshold of the pubertal period. The strong physical development during this period is not able to lessen materially the percentage of sickness, and the amount of sickness in these remains high in the case of both boys and girls" (†[53]). Dr. Hertel apparently agrees with Key of Sweden that the impulses of growth in the pubertal period tend to inhibit diseases, but the other unfavorable conditions, both external and internal, tend, on the other hand, to increase sickness. Thus he concludes, "Indeed, these unfavorable influences must be influential after the period of puberty, since immediately after this period, as soon as the accelerated period of growth and with it the greater power of resistance to disease, ends, sickness increases abruptly and very considerably" ([53]). His conclusion is based upon the following tables from the report of the Danish Commission:

TABLE M.

*Showing Percentages of Chronic Diseases in Danish Boys' Schools (Hertel).*

| | No. | AGE. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| Gymnasia, | 2,099 | — | — | — | — | — | 26 | 52 | 33 | 34 | 32 | 30 | 34 | 29 | 45 |
| Real Schools, | 4,343 | 15 | 24 | 29 | 30 | 30 | 28 | 29 | 30 | 29 | 22 | 26 | 31 | 25 | — |
| Bürger Schools, | 2,313 | 16 | 21 | 23 | 28 | 31 | 29 | 27 | 25 | 24 | 22 | 10 | 38 | — | 33 |
| City Volksschulen. Tuition, | 3,746 | 21 | 24 | 26 | 26 | 29 | 28 | 31 | 30 | 30 | — | — | — | — | — |
| City Volksschulen. Free, | 2,047 | 32 | 32 | 34 | 33 | 37 | 37 | 37 | 33 | 26 | — | — | — | — | — |
| Village Bauer, | 1,446 | 13 | 13 | 28 | 27 | 30 | 27 | 30 | 29 | 28 | — | — | — | — | — |
| Village Arbeit, | 938 | — | 28 | 33 | 30 | 28 | 30 | 35 | 25 | — | — | — | — | — | — |

([52]) P. 32. ([53]) Pp. 181-2.

TABLE N.

*Showing Percentages of Chronic Diseases in Danish Girls' Schools (Hertel).*

| | No. | AGE. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Higher Schools, Volksschulen. | 3,858 | 23 | 27 | 28 | 39 | 40 | 39 | 42 | 50 | 48 | 40 | 40 |
| City { Tuition, | 3,023 | 24 | 36 | 33 | 38 | 41 | 44 | 45 | 57 | 52 | -- | — |
| City { Free, | 2,018 | 31 | 37 | 40 | 42 | 51 | 48 | 60 | 55 | 53 | — | — |
| Village { Bauer, | 1,379 | 21 | 24 | 29 | 33 | 44 | 36 | 52 | 46 | 50 | — | — |
| Village { Arbeit, | 872 | 29 | 39 | 33 | 36 | 44 | 53 | 49 | 57 | 56 | — | — |

Combe of Lausanne reaches conclusions diametrically opposed to those of Key relative to the relation of growth and disease. He says (†[25]): "Sickness increases with growth; in other words, the more a child grows, just so much the more is it inclined to disease. The periods of most accelerated growth represent, therefore, the periods during which the organism possesses the least power of resistance to disease." He offers the following table, compiled from data of 2,000 school children of Lausanne, during a period of six successive years.

TABLE O.

*Showing Percentage of Sickness in Schools of Lusanne by Years (Combe).*

| AGE. | BOYS. | | GIRLS. | |
|---|---|---|---|---|
| | Per cent. of Sickness. | Annual Increases in Height in cm. | Per cent. of Sickness. | Annual Increases in Height in cm. |
| 8— 9 | 64 | 4.8 | 88 | 4.9 |
| 9—10 | 43 | 4.7 | 75 | 4.9 |
| 10—11 | 42 | 4.4 | 60 | 4.9 |
| 11—12 | 40 | 4.1 | 66 | 5.4 |
| 12—13 | 33 | 4.4 | 68 | 5.5 |
| 13—14 | 29 | 4.6 | 61 | 5.1 |
| 14—15 | 34 | 7.0 | 39 | 5.0 |

([25]) P. 581.

It must be remembered, however, that Combe's investigation is not comparable with those in Denmark and Sweden, for the reason that Combe includes a few of the infectious diseases; and further, he compares sickness with acceleration in height, while Key's conclusions are based upon comparisons with acceleration in weight which reach a maximum a year or so later. Combe, however, under some misapprehension, cites both Hertel and Key as supporting his view.

With regard to the period from 7 to 11 years in girls and 7 to 13 years in boys, Combe concludes that sickness is greater among the former than among the latter, and always increases directly in proportion to the rate of growth.

The studies, which have been reviewed with the exception of those of Combe, have dealt almost exclusively with the chronic diseases, ignoring the acute complaints. Another important field of data, therefore, is that of the normal epochs for the appearance of the usual children's diseases. Clouston's "Neuroses of Development" is a valuable handbook for the teacher, dealing with certain developmental diseases; chorea, for example, which is a disease of serious importance in pedagogy, occurs, according to Clouston, chiefly between the ages of 6 and 15 years: seventy-five per cent. of the cases occur during this period, and only fourteen per cent. during the period of adolescence. The publications of Crichton-Browne are also most helpful and important.

In the field of strictly medical literature, there is a mass of scattered facts bearing more or less directly upon the problem at issue. Dr. Boulton ([17]) says: "Arrest of growth or loss of weight precedes so many diseases that it may be looked upon as a danger signal, and if the 'caution' is noticed before the disease point is reached, catastrophe may frequently be prevented, and so, childhood may be worked on a kind of block system."

Dr. Moulton ([72]) offers several cases of insanity showing a direct relation between gain and loss in weight with improved or impaired mental condition of the patients. When patients improved, weight rose, and *vice versa*.

Dr. Evetzky ([32]) finds among infants that disturbances of nutrition incident to dentition are indicated by a decided diminution in the normal rate of growth.

Dr. H. P. Bowditch ([11]) says, "It has been frequently remarked that a period of rapid growth is apt to follow certain fevers, and it would, therefore, be very interesting to inquire whether this accelerated growth after the disease is anything more than a compensation for loss during the disease, and whether in this period of rapid growth the height and weight preserve their normal relation to each other." Dr. Bowditch offers an interesting chart in the same article tracing the variations in weight of an infant girl from September to April. The periods of slight sicknesses are coincident with loss in weight, and *vice versa*. The curve, however, is singularly like those due to seasonal changes, according to Malling-Hansen's law.

### Relation of Size to Precocity and Dullness.

Dr. Townsend Porter ([79]) from his study upon St. Louis school children concludes that, on the average, precocious

children are heavier and taller than their duller fellows of the same age. Dr. Porter's basis for this conclusion may be briefly summarized as follows: He tabulated the heights and weights of 34,500 boys and girls from the kindergarten through the high school. He then classified the pupils of the same age in tables, showing the school grades to which they belonged. Boys of 9 years, for example, are found to be distributed from the first to the fifth grades inclusive. He then calculated, by Galton's system, the mean weights for each age irrespective of grade, and also the mean weight of pupils of each age for each grade in which they are found. His figures very distinctly show, taking a given age, that the pupils of that age found in the higher grades are heavier and taller than the pupils of the same age found in the lower grades. For example, the mean weight of boys of 11 years is 68.47 pounds. Boys of this age found in the first grade weigh 63.5 pounds; in the second grade, 65.45; third, 68.12; fourth, 69.24; fifth, 71.29; sixth, 73.34 pounds.

Table P gives Porter's results, showing the distribution of girls and boys of the same age throughout the grades, according to weight. The figures for girls are in heavy-faced type, those for boys in light-faced.

Porter does not give complete tables with regard to height, but the following figures for boys of 10 years and girls of 12 years he considers sufficient to indicate the same law with regard to height:

| | Mean Height in Centimeters. | | | | | |
|---|---|---|---|---|---|---|
| | Grade I. | II. | III. | IV. | V. | VI. |
| Boys, 10 years, | 126.5 | 129.39 | 130.29 | 131.22 | | |
| Girls, 12 years, | | 136.06 | 139.04 | 140.08 | 141.96 | 141.9 |

Dr. Porter also shows a relation in the same manner between the chest at forced expiration and width of head to precocity.

In verification of his results, Dr. Porter cites similar but very much smaller investigations in Russia, one by Dr. Gratsianoff and another by Dr. Sack. Both found that successful pupils are larger and have larger chests than unsuccessful, but Sack disagrees with Gratsianoff that the rate of growth in the successful is quicker.

Dr. Franz Boas ([11]) criticises, in some degree, Dr. Porter's results, contending that what Dr. Porter has shown is that "mental and physical growths are correlated; not that mental development depends upon physical growth." Dr. Boas points out that naturally the sickly of a given age will be retarded in their advancement.

Three other attempts have been made to find a relation,

TABLE P.

*Showing Relation of Precocity to Weight as Indicated by Distribution of Heavy and Light Children of the same Age in the Different Grades of St. Louis Schools (after Porter).*

| Age at nearest Birthday. | Mean Weight Lbs. | GRADE. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kind. | I | II | III | IV | V | VI | VII | VIII | HighSch. |
| 6 | 43.74 | 43.58 | 45.29 | | | | | | | | |
| | 41.84 | 41.65 | 45.08 | | | | | | | | |
| 7 | 47.73 | 45.58 | 48.48 | 52.00 | | | | | | | |
| | 45.84 | 43.87 | 46.76 | 49.88 | | | | | | | |
| 8 | 52.58 | 47.80 | 51.79 | 54.43 | 57.00 | | | | | | |
| | 50.35 | 46.50 | 49.60 | 52.10 | 53.17 | | | | | | |
| 9 | 57.75 | | 55.87 | 57.64 | 59.66 | 61.75 | | | | | |
| | 55.17 | | 52.57 | 55.44 | 57.18 | 60.00 | | | | | |
| 10 | 62.48 | | 60.19 | 61.14 | 64.00 | 64.91 | | | | | |
| | 60.46 | | 57.00 | 59.59 | 61.15 | 61.64 | | | | | |
| 11 | 68.47 | | 63.50 | 65.45 | 68.12 | 69.24 | 71.29 | 73.34 | | | |
| | 65.64 | | 66.34 | 62.95 | 65.50 | 66.77 | 68.12 | | | | |
| 12 | 73.61 | | 70.00 | 69.50 | 72.17 | 73.86 | 74.69 | 77.29 | 76.50 | | |
| | 73.23 | | 71.75 | 69.80 | 71.50 | 72.74 | 75.13 | 75.92 | 78.50 | | |
| 13 | 79.85 | | | 74.25 | 75.95 | 78.43 | 80.90 | 82.17 | 83.50 | 82.00 | |
| | 83.73 | | | 79.50 | 76.50 | 81.92 | 82.78 | 86.95 | 87.63 | 88.50 | |
| 14 | 88.08 | | | | 81.00 | 84.00 | 87.83 | 87.20 | 93.63 | 97.50 | 86.50 |
| | 93.94 | | | | 90.50 | 87.17 | 92.67 | 94.64 | 96.15 | 99.00 | 103.12 |
| 15 | 100.20 | | | | | 89.00 | 95.33 | 99.17 | 105.50 | 105.17 | 105.08 |
| | 103.20 | | | | | 98.50 | 100.96 | 99.83 | 104.00 | 104.58 | 105.15 |
| 16 | 114.17 | | | | | | | 114.50 | 104.00 | 114.00 | 123.00 |
| | 110.06 | | | | | | | 108.12 | 107.38 | 110.29 | 113.57 |
| 17 | 115.69 | | | | | | | | | 111.00 | 116.00 |

either positive or negative, between prococity and physical growth: Dr. J. Allen Gilbert's studies upon Iowa and New Haven children, and the investigation of Toronto children by Dr. Boas. None of these use the test of precocity adopted by Porter, advancement in the grades, but take, as the test, the teacher's off-hand estimate or impression of quick intelligence.

Dr. Gilbert classifies the heights and weights according to the teacher's estimate of "bright," "average" and "dull." The number of children are about 100 for each year of age, 6 to 19. Upon this basis of test, there is no manifest relation. In weight, the bright children are slightly lighter on the whole and the dull children are heavier, most distinctly from 10 to 14 years. In height, about the same might be said. Dr. Gilbert feels justified in concluding, "The curves cross and recross in such a way as to show no constant relation between physical development and mental ability. If anything could be stated, it would be that the heavier and taller children are the duller, but here also the curves cross too frequently to justify any definite statement in regard to any relation so existing."

Dr. West with Dr. A. F. Chamberlain assisted Dr. Boas, in 1892, in making a study of children in the Toronto schools. The complete report is not yet published, but Dr. West has made a preliminary statement of results ([103]). The stature and weight were taken and grouped with reference to mental power, according to the teacher's impression, as "good," "average," "poor." Dr. West summarizes: "We find that, as a general rule, the 'poor' children are more fully developed than the 'good' children, though in each series of measurements, there are one or two cases when the 'good' children show a higher average than the 'poor.' These cases are generally near the latter end of the series." Dr. West, in discussing the disagreement of Toronto results and those of St. Louis, contends that an error pervades Dr. Porter's results, since a number of pupils enter school at a late age and would, therefore, be incorrectly counted as "dull" pupils; further, that Dr. Porter's system of reckoning age according to the nearest birthday introduces a misinterpretation of results.

The stature of the Fellows of the Royal Society is slightly above that of the professional classes of England (†[37]), and Roberts' tables show that the professional classes of England are distinctly taller than any other class. Roberts' tables also show that, compared with the general population, lunatics are shorter by 1.96 inches and lighter by 10.3 pounds. Clouston* finds that the 200 pupils of the National Institution at Larbert, England, are much under the normal average, both in weight and height. Dr. G. E. Dawson finds that in American institutions for defectives the children are distinctly undersized.

Dr. G. G. Tarbell of the Boston Home for Feeble-Minded

([37]) P. 21.
* "Neuroses of Development."

measured and weighed the inmates, ranging in age from 6 to 19 years, and constructed a chart, which by comparison with that of Dr. Bowditch indicates that the idiotic and feeble-minded children in that school are about two inches shorter and nine pounds lighter than normal children of the same age; that the relative rate of growth of the two sexes corresponds in principle with that of normal children and is subject to the same variations at the age of puberty; that the period of puberty is about two years later in idiots than in normal children.

A report by Dr. G. E. Shuttleworth of England confirms Dr. Tarbell's statements. The former gives a comparison of the heights and weights of 1,209 idiots and imbeciles in English asylums, showing a distinct inferiority as compared with heights and weights of normal children of corresponding ages. From data of 300 idiotic and imbecile children collected by Dr. Shuttleworth, he found that they were shorter than normal children by one inch at 5 years, two inches at 10 years, three inches at 15 years and 20 years. In weight, the defectives were lighter by four and one-half pounds at 8 years, at 10 years by six pounds, at 15 years by eight pounds, and at 20 years by twenty-three pounds. However, there are, as Dr. Shuttleworth points out, many factors that must be taken into account in comparison. They are more susceptible to disease than normal children, the mortality among them being probably nine times greater. Many are undoubtedly small at birth, and not a few have been prematurely born. The mortality curve follows Hartwell's law, being 50 per cent. for ages 5 to 10, 33 per cent. for ages 10 to 15, and 45 per cent. for ages 15 to 20.

## General Principles of Growth.

Since Quetelet, a half a century ago, gave an impetus to the study of the phenomena of growth in the human body, much data have been gathered, but as yet few, if any, conclusive principles have been clearly established. A few tendencies to formulate laws, however, should be mentioned.

*Growth by Rhythms.* Probably the most elaborate effort to present wide general laws has been made by R. Malling-Hansen. It will be remembered that the autumn season is the period of maximal rate in weight and the minimal period for height; that spring reverses the relation and that winter is a period of moderate increase for both. In the daily rhythm* the same relation was observed, that what the body gained in height by night it lost in

*The average daily loss for the 72 boys was .64 kilograms.

weight, and gain in weight by day was accompanied by an actual loss in height. These facts, harmonizing with other phenomena of growth, seem to justify the conclusion of Malling-Hansen that the periods of most rapid growth in height are, to say the least, periods of rest in growth in weight, and *vice versa*. A significant fact is that the height periods begin and end about fifteen days before the weight periods. The author cautiously suggests as a possible hypothesis that the circumstances "that height increases most rapidly when weight decreases, and also the fact that the phases of growth somewhat precede those of weight, appear to signify that the increase in height has been directly at the expense of weight increases. It has the appearance that the growth in height at the conclusion of its maximal period (which is just when the period of increase in weight begins) had consumed its food that had been stored up in the body; and as if, therefore, in the course of the autumn (which is the period of maximal growth in weight) the means for beginning a new height growth were then cultivated. On the other hand, however, the fact occurs that the maximal period of height growth does not follow directly the increase in weight (*i. e.*, the winter period of slower growth in both height and weight intervenes). It would seem, on a little reflection, that growth in height and growth in weight must be very different processes." Malling-Hansen gives a very plausible explanation of these processes. He argues that since during the autumn maximal growth in weight the vertical increase in height is slight, that, therefore, some other explanation must be sought for this weight increase. He thinks the length of the period, four and one-half months, precludes the explanation that the body is merely absorbing water. Aside from the possible storing up of nourishment for later height growth, he concludes that the growth in weight is due to lateral extension of the body, a growth in thickness therefore. During the middle period, from December to April, when the body is growing both in weight and in height, the increments of the latter must be estimated as a factor; but how much goes for the vertical dimensions and how much for the lateral we are, of course, unable to determine. In the spring and summer, when the body is increasing in height most rapidly, it actually loses in weight, and we must conclude that during this period the process of decay of cell structures exceeds the constructive process. A loss in the amount of water may possibly be reckoned as a factor. Malling-Hansen, however, feels justified in laying down the following principle of growth: "In the maximal period of lengthening, the thickening of the body is at its minimum, and *vice versa*; the thickening has its

maximum in the time of minimal lengthening." He measured also a number of trees for a number of months, the tables of measurements of which he gives, and found the same law sustained. In early spring the trees grew in height, and later rested in height while they thickened out in circumference.

A very scholarly contribution to the principle of growth by rhythms has been made by Dr. Winifred S. Hall from study of Haverford College students and grammar school boys. He develops the same law of separate rhythms for height and weight in the larger periods before and during pubescence that Malling-Hansen uses for the seasons. He concludes: "When the vertical dimensions of the human body are undergoing acceleration of their rate of growth, the horizontal dimensions undergo a retardation of their rate of growth, and conversely." As ground for this important conclusion, Dr. Hall cites the following facts from his data: "If the percentage series of total girths be represented by a curve, the rate of growth of the ninth year will be seen to continue through the tenth, thus surpassing the height. From the 11th to the 13th year the increase is less and less rapid, and is surpassed by heights; from 13th to 14th, more rapid, and surpasses height; from 14th to 15th, the girths are again surpassed by heights; but during the 16th year the girths gain a permanent and ever-increasing ascendency. That these curves cross each other four times between the 10th and 16th years is an exceedingly interesting fact. It may be considered as one of the most important laws of growth. A reasonable interpretation seems to be that the body widens and then takes an upward shoot, then widens out preparatory to another upward shoot. To make such a phenomenon possible it is necessary that the curves of height should show at least one period of rapid increase. The curve of heights shows (in his own data for males) two such periods, 12 to 13 and 14 to 15; Bowditch found two, 10 to 11 and 13 to 14; Pagliani, one, 13 to 17; Key, two, 12 to 13 and 15 to 16; Kotelmann, 12 to 13 and 14 to 15." According to Dr. Hall, the growth in height is due "largely to increase in the length of the long bones. If we can compare the girth of bones with their length, we shall find the same thing true of bone growth as of general body growth. The increase from 9 to 12 is unchanged, but when the bones begin to increase rapidly in their vertical dimensions, from 12 to 13, we find the increase in lateral dimensions essentially retarded, and when the vertical dimension undergoes its second retardation, between 13 and 14, the joint girths make an increase which more than makes up for their previous retardation." Dr. Hall makes this conclusion general.

Peckham (†[76]) concludes: "The growth of the body and of the lower extremities takes place in such a way that the length of the body of the girl is less than that of the body of a boy until the 10th year, and thereafter greater until the 16th year. From 15 to 18 years the bodies of girls grow only two inches and the bodies of boys over four inches. For the lower extremities, at nine years of age those of the girl are longer, at 11 shorter, and from 12 to 14 again longer. At 14 the lower extremities of the girls almost cease growing, while those of the boys increase by four inches between the ages of 14 and 19 years.

This rhythm of alternating activity and rest in growth finds at least its analogy in cell multiplications and growth. The means of increase in number among cells of an organism and among the lowest orders of living matter is by division. The parent cell swells in size until a certain point is reached, and then, by a more or less complex process, divides into two parts. A period of rest then generally ensues, and somewhat later these two cells begin to swell and repeat the process. Whether this principle of activity and rest here exemplified has a direct relation in the growth of the complex higher organisms is, of course, a matter of mere speculation. Minot (†[69]) points out that probably changes in one direction are counterbalanced by changes in an opposite direction, thus maintaining, it would seem, a balance on the average.

*Growth by Parts.* It has been a popular notion of growth that the process is continuous throughout the body; that if, for example, a cross-section of the various parts and organs were taken in equal divisions of time, the amount of growth in each part or organ would be found in the same proportions. The studies in physiology and anthropometry during the past half century or so have turned the drift of conviction toward the other extreme, and the problems of the present are those of "retarded" growths and "accelerated" growths, not only of the organism as a whole, but also in specific parts. While each part may be assumed to have some sort of relation to other parts, nevertheless the modern tendency is to discover the growths of the parts individually as a basis for investigation of the relations and dependencies of one form of growth, or the growth of one part upon the others. From the physiological standpoint, probably the most complete presentation of the data relative to this subject, collected and contributed, has been made by Vierordt.†

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([76]) P. 35. See also pp. 32-33.
([69]) P. 195.
†Gerhardt's *Handbuch der Kinderkrankheiten, erster Band, erster*

Further, physiologists distinguish between a growth by increase in the number of cells and a growth consequent of mere swelling of cells already existent. The unstriped muscles, for example, actually increase in number of cells; but the number of cells in the brain, on the other hand, does not increase after birth — they simply swell in size. A third kind of growth is to be distinguished in the replacement of cells that have decayed. Still another complication of the growth problem arises in the increase in fat. This is not generally termed growth. After twenty-five years of age there is generally an increase in fat, materially adding to weight, and thus making it difficult to determine the exact amount of real growth. At best, therefore, growth in stature and weight is merely significant perhaps of activity of growth processes taking place in several parts of the body at once. To trace these growths in detail would far exceed the limits of this study, and would lead deeply into anatomical and physiological problems. That growth is relative in the different organs is neatly illustrated in a table by Bischoff, quoted by Donaldson (†[29]), showing the percentages of weight of different parts or systems of the human body at birth, at sixteen years and at maturity. Commenting upon this table Donaldson says: "On comparing the proportion of the different systems in the new born with the adult, the following relations are worthy of remark: The percentage of the skeleton, fat and skin taken together, is but slightly smaller in the new born. The percentage of the viscera in the new born is nearly twice that of the central system, and more than eight times that found in the adult, whereas the proportional weight of the muscles shows only a trifle more than one-half its adult value. The purely constructional parts of the body, the skeleton, fat and skin, which are formed predominantly of connective tissue, have therefore not varied their proportions during growth; while the nutritive and controlling system, that is, the abdominal and thoracic viscera and the brain, have undergone a relative diminution, having in a most remarkable way been outgrown by the muscular system."

From birth to complete maturity the body increases in height 3.37 fold, and in volume 20.66 fold (†[29]). Roberts (†[32]) gives a succinct résumé of relative growths of different parts of the body. The

*Abtheilung*, 1881, contains a résumé by Vierordt of the subject to date, 288 pages with abundant tables. In the same volume is also a valuable collection of data upon the anatomy of children by Henke. Vierordt's *Physiologie des Menschen* (1877) and his *Anatomische Physiologische* and *Physikalische Daten und Tabellen* contain a mass of collected data of immense value.

([29]) P. 67. ([29]) P. 50. ([32]) P. 108 *et seq.*

head doubles in height, and the development of all horizontal measurements of the head is still less than that of its heights. It is not till about the sixth or seventh year that the neck commences to grow, and after adolescence averages about two inches. The diameter of the neck increases rapidly at the pubertal age. The height of the trunk of the body trebles from birth to maturity. The diameters of the trunk at the shoulders, chest and hips grow proportionally with the height; but the diameter of the chest, front to back, doubles toward the age of puberty. The change in relative proportions is shown by the fact that while at birth the point which divides the total height into two equal parts is a little above the navel, this point gradually sinks until in adult man it is about half an inch below the pubes, and in woman a little above. The lower extremities are about five times their length at birth. The arms are about four times the birth length. Probably one of the most careful series of measurements in this field is that of Dr. Landsberger of Posen. Dr. Landsberger measured in 1880, 104 children, and continued these measurements annually for seven years.

Vierordt (†[93]) gives the following table of lengths from computation of various measurements, showing the growth of various parts of the body, the size at birth as unity. Thus, taking the first line to illustrate, the child's head grows in length during the first 21 months of life half its length; at the end of seven and one-eighth years, 91.7 per cent. and at maturity the head is twice as long as at birth.

| | Birth. | End of 21st Month. | Seven one-eighth Years. | Adult. |
|---|---|---|---|---|
| Length of head, | 100 | 150 | 191.7 | 200 |
| Upper part of head, | 100 | 114 | 150 | 157 |
| Length of face, | 100 | 200 | 250 | 260 |
| From chin to upper end of breastbone, | 100 | 500 | 700 | 900 |
| Breastbone, | 100 | 186 | 300 | 314 |
| Abdomen, | 100 | 160 | 240 | 260 |
| Leg, | 100 | 200 | 455 | 472 |
| Height of foot, | 100 | 150 | 300 | 450 |
| Upper arm, | 100 | 183 | 328 | 350 |
| Forearm, | 100 | 182 | 322 | 350 |

*Theory of Compensation.* In the suggestion of Dr. W. S. Hall and Malling-Hansen (see pp. 299-301), that growth in height

([93]) P. 272.

during the resting period of growth in weight is at the expense of the latter, we have the suggestion of an important theory of the process of development which will appear in the treatment of later forms of growth, more especially in the psychic field. It might aptly be called the theory of compensation, and perhaps may be regarded as the antithesis of growth by parts. In the lower metazoic forms of life we find a colony of cells or group of cells, each an individual, as it were, capable to all appearance of practically all the functions of the whole. A bit of begonia leaf will reproduce the entire plant; if we section a centipede into parts, each part to a limited extent is capable of doing business on its own responsibility. Weismann's great attack upon the doctrine of transmission of acquired characters depends upon the contention that the reproductive cells are absolutely independent of all other parts of the body (except in conditions of nutrition), thus preventing peculiarities acquired during the life of a parent to be transmitted to offspring. In the human body the digestive system to a great extent is an independent organism supplied with its own nervous system and capable, up to a certain limit, of performing its duties without the interference of other parts of the body. Flechsig† has shown that in the development of the nervous system there is a growth by parts. The different strands of fibres in the spinal cord, and the fibres leading to different areas of the brain, commence their growth at certain specific periods, and grow in seeming independence of one another. We have here the theory of parts. Now, in how far is this true as a general principle of growth? In how far may we regard growth as a process dependent upon processes and functions contained within the part concerned? In how far does the growth of one part depend upon functions in other parts? We do know that, past a certain limit, the digestive system is essentially dependent upon other systems; that defect in blood supply affects every part of the organism. But in how far does the growth of the legs affect growth of lung capacity, the development of the brain centres of hearing affect the brain centres of sight, favorably or unfavorably; or, to go further, in what way does the exercise of the physiological factors concerned in memory affect those concerned in what we call reasoning? These are far-reaching questions, and as yet there is no answer whatever to them. On the one hand we have inferences that to a certain extent, and probably to a greater extent in some parts than in others, these parts are independent organisms, governing their growth and

†*Die Leitungsbahnen im Gehirn und Rückenmark.* Leipzig, 1876. Also *Gehirn und Seele.* Leipzig, 1896.

exercise by forces resident within themselves as individuals. On the other hand we have inferences of the principle of compensation by which each part is dependent upon other parts, at least for certain services, and to some extent governing other parts. Does growth in height, for example, borrow the food supply which the forces of weight have stored up? Is this loan compensated to weight in some way, so that without an advance in height there is no extension in weight or an impairment of it? Existence and growth by parts and by compensation are correlative and opposing theories of significance, not only to biology, but to education at every step.

The determination of these principles, growth by parts and compensation and their relative scopes of activity, underlie the crucial problems of growth and education.

*Persistence of Growth.* There is a tendency to establish as a principle that each individual organism strives to reach some size particular to that individual. If disease in any way interferes with this progress in its natural course, the organism later seems to make redoubled growth to make up for the accidental loss. Pagliani† points out this fact in the surprising recovery of children placed under favorable nutritional conditions after a period of poverty. It is a general fact of medical observation that sickness in growing children is accompanied by a loss in weight and retardation in height, and that, seemingly in consequence, convalescenee is followed by very rapid growth, apparently indicating that the organism is striving to make up for the loss. Minot (†[70]) has shown this in his experiments with Guinea pigs, and he concludes from a significant array of facts that "each individual appears to be striving to reach a particular size. The fact, which I have thus expressed, is that if an individual grows for a period excessively fast, there immediately follows a period of slower growth, and *vice versa*; those that remain behind for a time, if they remain in good health, make up the loss (at least in great part if not always completely) soon after. Indeed, to permanently dwarf a Guinea pig requires an astonishingly prolonged interference; thus a young pig may lose one-third of its weight from a severe intestinal catarrh and yet make it up subsequently. The number of similar observations is so great that we might assert safely that a pretty severe and prolonged illness will not affect very much the ultimate size. It is probable that the same is true of man, and that, therefore, the usual and even the severer illnesses of childhood and youth do not greatly affect the ultimate size of the adult." A

†So Sviluppo umano.
([70]) P. 134.

forcible illustration of this struggle, seemingly of internal and perhaps hereditary forces, to obtain for the individual a specific size, is offered by Camerer ([23]), who found, as stated, that however different the diet by which infants during the first year of life were nourished, all of approximately the same weight at birth reached practically the same weight at the end of the first year; the curves, however, show significant fluctuations at times during the year, suggestive of a struggle of the internal forces of the organism to combat the unfavorable external influences.

*Accelerated Growth in Large and Small Children.* The contribution made by Dr. Bowditch ([20]) in his application of the Galton method of percentile grades† to the heights and weights of Boston children is what seems to show that large children make their pubertal rapid growth at an earlier age than small ones (of the same age). The age at which the maximum yearly growth in height and weight is reached is distinctly earlier in the percentile grades (for the same age) representing the children who are taller and heavier. The range for the beginning of the prepubertal acceleration according to size is from 12 to 14 years in girls and from 14 to 16 in boys. Large boys grow at an accelerated rate longer, but not necessarily more rapidly than small boys; this phenomenon Bowditch does not observe in his data for girls. The law does not apply apparently to children under ten years. But the theory of large and small children rests upon the assumption that a child, who in a certain degree is larger or smaller than the mean of his age, maintains throughout this growth this degree of deviation, that the small child of one year of age is the small child of the next. Dr. Boas in two articles* has attacked this theory, and his argument seems convincing that such an assumption is untenable; for the small child of one age may be the large child of the next age. This criticism undermines the value of many of the conclusions drawn from Galton's percentile method of calculation.

*Co-education of the Sexes.* Growth, so far as height and weight are concerned, seems without sex conditions up to the period of prepubertal increase. Girls and boys grow practically at the same rate from birth to ten or eleven years of age, and the form of their curves of growth is practically the same. There are, it is true, some slight differences to be observed. The Swedish Commission has found that the growing female

†For explanation of this method see Francis Galton's "Natural Inheritance."

*Science*, Dec. 23, 1892, and March 1, 1895.

body reacts more strongly to outward influences that the male, and Schmidt, in his Saalfeld investigation, strongly corroborates this conclusion. He finds that boys grow more regularly than the girls, and this fact is amply borne out by a study of the fluctuations in the charts. However, as a rule, these conclusions apply more particularly to the adolescent period, and it is doubtful that they materially affect the period up to the prepubertal accelerations. These differences are not so significant as materially to modify the statement in its practical import, that children's growth until their eleventh or twelfth year is unsexed. With the beginning of the prepubertal increases and the concomitant changes, which the violent fluxes in height and weight indicate, the statement is reversed. These facts are of the greatest import to the solution of the problem of co-education of the sexes. We may easily conclude, with slight fear of contradiction, that so far as growth by height and weight indicates there is no reason for the separation of the sexes for the first four or five years of school life. Beyond this period there certainly are grave reasons for questioning the system of co-education, upon grounds of physical dissimilarities, not to discuss the mental dissimilarities of girls and boys of the same adolescent age. But the latter period belongs properly to the treatment of the adolescence. On the continent, the rule has been in the past generally in favor of separation, the tendency extending even to the primary classes. A reaction in all countries that have separated primary classes has recently set in, and the tendency toward co-education is extending upward through the grades. Burgerstein† concludes a succinct review of the co-educational problem and the recent reaction against the system in the primary schools: "So far as the data for decision of the question are concerned, the demand for the separation of the sexes has been made and accomplished on *a priori* grounds, but from practical experience the presumptive moral grounds are not as sound as they have hitherto appeared. This is true, at least, for the Volksschulen (primary school)."

*Biological Considerations.* Little has been accomplished thus far in conforming the phenomena of human growth to biologic laws. The modern theories of Weismann carried to their logical extreme would seemingly place this entire field of anthropometric phenomena in a new light. Dr. C. S. Minot, however, in one or two papers has made a preliminary contribution to this aspect of the problem. He gives to senescence the place of a positive factor which is struggling from birth

†*Handbuch der Schulhygiene*, Burgerstein and Netolitzky, pp. 226-30.

onward with the annabolic or up-building processes. In the earlier period of life, growth has the upper hand — the processes of annabolism do more work than those of senescence, which ever tend to tear down what the other has builded. Growth, Dr. Minot claims, is the product of four factors ([68]): The rate of multiplication of cells, (2) the frequency of division, (3) the weight of cells, (4) the loss of cells. In the earlier periods of life, the multiplication of cells, the essential factor of growth, is so rapid that the increment of senescence is less than the increment of the number of cells. "At each division, therefore, the multiplication of the cells obtains the upper hand and the rate of growth increases; soon, however, the increment of senescence surpasses the increment of multiplication, and thereby renders the rate of growth less, until at last the excess of senescence becomes so great that growth ceases, or at least becomes so insignificant that it only serves to counterbalance the loss of cells." Some such principle established and applied to the fluctuations of growth offers a suggestive field of explanation.

The reaction of the reader of this field of investigation must be that of a sense of the extreme complexity of the problems involved. Every result is the product of several factors, and in each community these factors vary at least in the proportion of their mixing. Of the many studies made upon the same or allied problems, there are few that are directly comparable in close detail, so that for conclusions we must content ourselves with expression in the broadest terms until the studies have been so multiplied and repeated under similar conditions that details may be compared. For example, in the matter of the relation of disease to growth, Hartwell in Boston deals with deaths from all diseases, Combe with acute complaints, and Warner with still another classification. The social environment, the school hygiene and climate are varying factors in each case. Moreover, Hartwell's calculations are upon the exact age in years, while Key's ages are obtained largely by averaging ages of the pupils in any school grade. Therefore each study must be taken to a large extent by itself. Further, for the immediate interests of psychology, none of these studies have been carried far enough on psychological lines to satisfy the suggestions which they arouse. We want Dr. Hartwell to tell us the mental condition of these children who died — their relative mental strength compared with those who lived; we want to know from Key, Hertel, Combe and Schmidt-Monnard the mental conditions of those unhealthy school children compared with the healthy ones, so that we may estimate the actual effects and importance of health upon

the mental growth and power; we should like to know the comparative rate of progress of these two classes of children in school — the immediate mental effects of the different diseases upon the nervous system. But Key, Hertel, Hartwell and Schmidt-Monnard are physicians. They have seen these facts from the physician's more or less special standpoint. They have framed their tests accordingly. Is it not the high noon of urgency that the psychologist and pedagogue, from their apperceptive standpoints, were studying these conditions critically, applying their tests and framing courses of practical application? However, on the other hand, while these finer details have not yet been worked out, we are certainly ready to conclude from what all studies unanimously show, that there are rhythms of susceptibility to disease varying with the age of growing children. There are times when the organism is more liable to disease than at others, and the coincidence of these periods with periods of activity and rest in the growth, as shown by height and weight fluctuations, forcibly suggests an organic connection between disease and the growth of specific organs and parts of the body. While it is difficult to trace the details, nevertheless, it seems as though life were a specific thing, and when most active also most tenacious of its prerogatives. Dr. Warner also inclines strongly to the theory of a growth energy, which, when impeded in its natural metabolic functions, expends itself in some other channel, as likely to work harm as good. If this be true, what is the significance to the psychologist and pedagogue? If the function of the pedagogue is to develop the greatest amount of mental strength, then it behooves him to give part of his attention to the duty of obtaining for the nervous system of his pupils their fair share of this vagrant growth energy, so persistently and often mischievously seeking an employer. If disease not only checks nervous growth, but, coming at specific growing periods, permanently dwarfs certain areas of nervous action, then the loss of a Latin root or so is not to be compared with the loss of that which never can be replaced. What may be the factors upon which this development depends? If the body is an autonomous interacting democracy, as up to certain limits we clearly have a right to conclude, we cannot escape the conclusion that in disease of muscular tissue, nervous tissue must in some way be affected. Who can say at present how far-reaching and how permanent may be the effects upon a brain in its nascent period, of an affection outwardly manifested by a simple headache? In Denmark and Sweden we find that between 30 to 75 per cent. of the children in growing ages are affected by chronic diseases alone. In America no such investigation has

ever been made. We have reason to suppose that the percentage must be much less. If true, are the children living in America mentally stronger? Have we a right to give them stronger school work? Can we still lessen the amount of disease, and in how far may we thereby develop men and women stronger intellectually? The study of these facts but starts up suggestions of problems, as sharply important to the parent, pedagogue and psychologist as to the physician. The ground has scarcely yet been broken, and the pioneers who have been cited cannot begin to answer the practical questions of pedagogy and psychology which impatiently demand an answer.

From the studies in nutrition it is shown that the child of favorable conditions, at any given age, is very significantly heavier and taller than the child of unfavorable nutrition and social life. What does this additional height and weight of the favored class signify — merely increments of bone and muscle? Here, then, is unquestionably also a new province for psychology. The anthropometrist has merely given us an unhusked fact, stating that lack of nutrition stunts growth, without telling how much of this loss belongs to muscle, how much to nervous tissue. It is impossible to speculate clearly before we know more of the factors involved, and the psychologist, if he expects psychological results, must take off his coat and investigate for himself. We do not know clearly at what periods of growth effects of mal-nutrition are most pronounced. The evidence wavers between the period before puberty and the period during puberty. If before, what shall we say of possible permanent dwarfing of brain power in that nascent period of rapid growth up to the eighth year, before the brain is said to reach its maximum weight. Roberts has data which seem to indicate that children stunted by unfavorable conditions make permanently smaller men and women. Does this stunting not affect the mental power? This does not mean to imply that small men are mentally duller than big men, for we have seen that there seems to be for every individual his particular size, and to attain which every organism seems to make a significantly desperate struggle. The problem seems, not how to make the child grow big, but how to keep the track clear so that each organism may obtain its particular size. Brer Rabbit, though smaller, is quicker witted than Brer Fox, it is true, but there is no telling how untimely would have been the fate of Brer Rabbit had he been stunted in his early infancy and prevented from reaching his diminutive but particular size. It is a singular fact that the members of the Royal Society of England average taller than any other class of men. Throughout, the professional classes

are distinctly taller than those of the lower classes. What factors are involved? If race is the single factor, then the matter is of least theoretical interest to psychology, but if, as the facts which have been reviewed seem to indicate, nutrition, freedom from accidental disease and social environment are also essential factors, then the facts become of crucial importance to pedagogy and psychology on practical grounds.

Dr. Porter has thrown down the gauntlet resonantly, in the conclusion from his data that among children of the same age, the taller and heavier are more precocious. His facts seem to decide at once that increments of height and weight imply increments of those nervous tissues which make for mental acuteness. Dr. Porter has been sharply reviewed. Dr. West, upon the basis of another test, declares the direct contrary. There are three conclusions involved in the form in which Dr. Porter sums up his evidence: (1) That there is a relation between size and mental activity, (2) that size is the direct causal precedent to mental condition, (3) that large size is the cause of precocity. It is clear at once that the second and third conclusions may be quite wrong, and yet, the first remaining, the data with which he deals are psychological in character. It may be true that Dr. Porter is wrong in finding that precocity accompanies large size—it may be an accompaniment of small size. Or, as Dr. Boas criticises, Dr. Porter may be wrong in concluding that the height and weight are the material causes of mental acuteness, and yet these two effects may proceed from a common cause. It may be, for example, that these precocious children enjoyed better nourishment, and the food supply contributed to build up both muscular and nervous tissues at the most favorable periods and under the most favorable conditions. Or, as Dr. Boas also criticises, the facts Dr. Porter presents may be accounted for on the assumption that children who are taller and heavier are so because they have escaped diseases and the organism has had opportunity for free growth, nervous as well as bony and muscular. But neither criticism vitiates the facts for the psychologist, for both emphasize the importance of the physical conditions of nutrition and freedom of disease as factors directly or indirectly making for intelligence. Dr. West, in his preliminary report upon the Toronto investigation, states that the results are just the reverse of Dr. Porter's conclusion. The large children are duller and the small children more precocious. We have here, then, a direct contradiction, though from the standpoint of different tests.

Dr. Gilbert's studies in Iowa and New Haven and Dr. West's Toronto study are hardly comparable. A teacher's

judgment is as questionable as the test of promotion, and, further, this judgment only speaks for the present. It may be the present is the child's period of rapid growth, or the period of slow growth. Dr. Gilbert and Dr. West should tell us whether, at the time the teacher's judgment is made, the child is growing rapidly or slowly. Dr. West points out that some children enter school a year or two later than usual, and, being older, are therefore taller and heavier, and consequently these children tend to raise the averages of the larger children in each grade. This is undoubtedly a factor of error, but, on supposition, it can hardly be concluded there are so many children who enter school late as to affect all these results so materially as to overthrow them. None of these criticisms can be substantiated by mere argument. We must have duplicate tests made, and tests made from a psychological standpoint with attention to these disputed factors. We need supplementary data on Dr. Porter's study to tell us the age of children entering school, the course of health and nutrition of the large and small classes, the teacher's judgment at periods of rapid growth and periods of slow growth. Not until then can we determine the more exact relations. But this is work for the psychologist. From the standpoint of general experience, it would be singular if Dr. Porter's conclusion is sustained. The stunted tree fruits earlier. The starved street gamin is more precocious than the well-groomed child enjoying four meals a day and growing *ad libitum*. Mr. Bohannon* in his studies of exceptional children finds that large children naturally associate with children older than themselves, and small children with those younger than themselves; it may be consequently that we must reckon with the effects of this factor in considering the precocity of large and small children.

One chief pedagogical problem to be solved is whether children are able to do their best mental work in their growing periods or in their periods of rest from physical growth. We have seen that, on the whole, the period from 6 to 10 or 11 years in girls and from 6 to 12 in boys is a period of general decreases in the rate of growth. Perhaps in the earlier portion of this period, there is a slight increase, but the latter two or three years are undoubtedly one of inactivity of the processes which make for bodily growth. From the prepubertal acceleration in the 11th or 12th to the 15th year in girls and from the 12th or 13th to the 17th in boys, we have tumultuous changes and rapid growth. Now, shall we say with Key and Hartwell that the periods of most rapid growth

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are the periods of greatest resistance to disease,—and, inferentially, that the same periods are those in which the child is most active mentally? Shall we say with Porter that the taller and heavier a child is for his age, the brighter he is mentally,—and, inferentially, that the periods of rapid growth are the periods when he is most capable of mental work? If we are satisfied with the evidence and inference, then the period from entrance in school until the prepubertal acceleration is one of comparative mental inertia, while the period of puberty is the time *par excellence* for the strain of school work. Or, from the same data of growth rate, shall we not invoke the theory of compensation and conclude that when the child is growing fastest in bone and muscle tissue, therefore he is resting mentally: that, therefore, the period before the prepubertal increase is the true period for mental activity and the period of active pubertal growth the time for mental rest. A third alternative view is offered by the theory of growth by parts. In the light of this theory, we would conclude that the nervous and muscular systems are to a considerable extent independent systems, and the periods of rest or growth in one have no important and immediate influence upon the other. If we take this view, then we must next consider the growth of the nervous system. This subject must be treated in a subsequent chapter.

Shall we not say in conclusion, then, that this new territory, the problem of growth, is properly a province of psychology? A surgeon's knife and saw have transformed feebly-gifted children into children with normal intelligence. The alienist, from the insane ravings of his patient, has, in some forms of the affection, been able to declare in advance of autopsy the anatomical situation of disease—a lesion in that area, a blood clot in this. The old psychologist is forced to admit that, in certain particulars at least, the physical modifies and conditions the mental, but he hastens to pass by these facts with averted eye as minor details, exceptions, apocrypha, matters for foot-notes and appendices. On the contrary we have before us some vitally important problems in pressing need, upon practical grounds, of early solution. Has the time not come, as when the child, become man, puts away his childish things, so the psychologist may leave to the gymnastic and disciplinary period of his training the old enigmas which require for their solution the complete explication of God and cosmos? Is the time not here when the psychologist may not legitimately push out inquiry into the domain concerned with the modification of the growing mind by sex, race, nutrition, disease, and by rapid and slow rates of metabolism?

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19. BOWDITCH, DR. H. P. The Growth of Children. Tenth Annual Report of the State Board of Health of Massachusetts, pp. 35-62. This constitutes an investigation supplementary to the first investigation, and deals more directly with the problems of the relative importance of mode of life and of race in determining the size of growing children. It contains eleven tables and eleven plates. The first nine tables segregate the data of the first investigation into classes; first of races, American and Irish, and then under each of these titles, the children of parents whose occupations are professional, mercantile, skilled labor, and unskilled labor. The sexes are, of course, separated. The last two tables deal with occupations of parents, irrespective of nationality, giving the heights and weights of the children of the laboring and non-laboring classes, males and females. The plates give the growth of each of these classifications in graphic form.

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tors to this field: Russono, Fleischmann, Vierordt and Malling-Hansen. Among his more important tables are the following: Weekly average weights for the first year of fifty-seven infants nourished by mother's or nurse's milk, of thirty-one infants with artificial nourishment; twenty-eight infants upon a mixed diet of woman's milk and artificial food; average yearly growth in height of a few children, arranged according to social classes of three or four, for the period from birth to maturity; daily fluctuations in weight of individuals of different ages; weights of about sixty individual children for the first year of life under different forms of nourishment specifically stated for each.

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ages, grouped by ages according to height. A comparison is made between the heights at the different ages of the children in the Freiberg Bürger school and those of the peasant classes in the outlying towns and the results showing a greater average height of the former at a given age, are given in tables and also graphically. In addition there is a careful mathematical study of the probable error involved, concluding that the arithmetical average is not suitable for practical application and offering a formula for correction.

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49. HANSEN. Ueber die Individuellen Variationen der Körper Proportionen. Archiv. f. Anthrop., Bd. XX, p. 321.

50. HARTWELL, E. M. Report on Physical Education in the Boston Public Schools, 1894.

51. HERTEL, DR. AXEL. The Danish Commission was appointed in 1882 and investigated the health of 17,595 boys and 11,646 girls, partly in the higher schools, partly in Volksschulen, both in Copenhagen and in the country. The matters considered were: age, length of work, time at school and at home, height, weight, and diseases, chiefly scrofula, anæmia, nervousness, headache, nosebleed, chronic indigestion, chronic lung and heart complaints, spinal curvature, and other chronic diseases such as those of the kidneys, joints, etc. Since both higher and Volksschule pupils were investigated, the report treats of the effects of social environment. The results of this commission, those of the Swedish Commission, and of his own are reviewed and discussed by Hertel.

52. HERTEL, DR. AXEL. In 1881 Dr. Axel Hertel, Kommunaler Kreisarzt in Kopenhagen, published (in Danish) a report of an examination of growth he had made upon 3,141 boys and 1,211 girls, all pupils in the higher schools of Copenhagen. The report showed the growth and prevalence of chronic diseases among children for different ages. The information was obtained from the parents and family physicians. The results of this study will be found briefly reviewed in an article by Dr. Hertel (see No. 53). An English translation of Hertel's book by Godfrey Sörenson is published by Macmillan, 1885, under the title of "Overpressure in High Schools of Denmark."

53. HERTEL, DR. AXEL. Neure Untersuchungen über den Allgemeinen Gesundheitszustand der Schuler und Schulerinen. Schulgesungheitspflege, 1888, Nos. 6 and 7, pp. 167-183; 201-215. This is a review and comparison of the result of his own, of the Danish Commission's and the Swedish Commission's investigations upon the age, height, weight, and chronic diseases of children between 6 and 17 years of age. He charts the curves of the per cents. of diseases at various ages, and discusses the results in their relation to age, physiological conditions, school and home duties. In the second article he gives the chief tables of the two commissions and discusses the problem of school hygiene from this standpoint. The most important contributions of the Danish and Swedish Commissions are here reviewed, and the most valuable of the tables are reproduced.

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der Körperlänge bei einem Kinde im ersten und zweiten Lebensjahre. Archiv. f. Gynækologie; Berlin, 1881.

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56. HOLMES, B. Study of Child Growth. *Intelligence*, Vol. XIV, p. 323.

57. HUDSON, G. H. Phenomena of Child Growth in Education. *Education*, Vol. XIV, p. 466.

58. KEY, AXEL. Läroverkskomiténs Betänkande III. Bilage E. Kongl. Boktryckeriet. Stockholm, 1885, 2 vols. The work is edited in German, somewhat condensed, by L. Burgerstein, under the title, "Schulhygienische Untersuchungen, Hamburg and Leipzig, 1889." This constitutes the report of the Swedish commission of which Axel Key was the head, appointed in 1882 by the government to investigate the hygienic conditions of the schools. The report deals with data from 15,000 boys of the Swedish middle schools and 3,000 girls in private schools. The original contains a volume exclusively devoted to elaborate tables and curves. The greater portion of the report is occupied by hygienic investigations, shortsightedness, influence of work upon health, possibilities of instruction, sleep, relation between health and hours of sleep, conditions of home surroundings, etc. A chapter, however, is devoted to the development in length and weight at different ages from 6 to 20, boys and girls. The most signal contribution of the report is that showing the relation of disease to the periods of rapid and slow growth. The results of the Swedish commission are compared and discussed by Dr. Axel Hertel. (See No. 53.)

59. KEY, AXEL. Die Pubertäts Entwickelung, Verhandl des Internat. Med. Congress zu Berlin, Bd. I, 1890, p. 67 *et seq.*

60. KOTELMANN, DR. L. Med. u. Phil. Die Körperverhältnisse der gelehrten Schüler des Johanneums in Hamburg. Zeitschrift des Königlichen preussichen statistichen Bureaus, Jahrgang, 1879. This is a very careful study upon 515 boys, 10 to 15 years of age, giving accurate data upon growth in height, weight, strength, lung capacity, vital force, etc.

61. VON LANGE, EMIL. Die Normal Körpergrosse des Menschen, München, 1896.

62. LIHARZIK, F. Das Gesetz des Wachstums und der Bau des Menschen, etc., Vienna, 1862.

63. LANDSBERGER, DR. Prakt. Arzt in Posen. Das Wachstum im Alter der Schulpflicht. Archiv für Anthropologie, Vol XVII, pp. 229-264. This is a study upon the individual plan. Dr. Landsberger measured a number of children from 1880–1886, partly of German and partly of Polish parentage, partly of the favored class and partly of the poorer classes. There were originally 104 children, but the number fell off from year to year, and in 1886 there were but thirty-seven remaining. The measurements are from 6 to 13 years of age. In addition to height there were twenty-four other measurements: Distance from finger-tip to finger-tip with arms outspread, height of left shoulder, right shoulder, middle finger-tip, height of hip bone and of knee, length and width of skull, circumference of neck, length of breast bone, circumference at breast, circumference at navel and others. He discusses the differences in height relative to race, obtaining negative results; with reference to effects of nutrition, disagreeing with Bowditch that race is a more important factor than nutrition. A table at the close gives in detail the measurements by years. Each series of measurements is discussed with care and in comparison with the results of other investigators.

64. MALLING-HANSEN, P. Perioden im Gewicht der Kinder und in der Sonnenwärme, Kopenhagen, 1886. The contents of this book

are summarized in this article. An accompanying volume of charts illustrates graphically the tables of growth.

65. MALLING-HANSEN, PASTEUR R., Directeur de l'Institution. Einige Resultate der täglichen Wägungen von 130 Zöglingen des Köngl. Taubstummen-Instituts in Kopenhagen. Congrès Périodique International des Sciences Médicales. Copenhagen, Vol. III, pp. 103–119. The first portion of this address covers the matter of seasonal periods and weekly, more extensively and carefully treated in his later publication (No. 64). The latter part deals with an experiment upon a change of diet in the institution, and shows the effect of good nutrition and the fact that improved food affects growth in weight only at certain definite times of the year. The facts are graphically illustrated by nine charts.

66. MALLING-HANSEN, PASTEUR R. Ueber Periodicität im Gewicht der Kinder an Täglichen Wägungen. Fragment I, Kopenhagen, 1883, p. 35. This monograph is a brief preliminary report upon the observations more extensively treated in No. 64. It deals chiefly with the seasonal periods of growth, the daily variations due to atmospheric temperature.

67. MEEK, K. Volummessungen des Menschlichen Körpers und seiner enizelnen Theile in den verschieden Alterstufen. Zts. f. Biologie. München und Leipzig, 1894, pp. 125–47.

68. MINOT, DR. C. S. An article in Harvard Medical School Laboratory Papers (1873–9) upon the biological factors of growth.

69. MINOT, DR. C. S. Human Growth, *Boston Medical and Surgical Journal*, July 22, 1880.

70. MINOT, DR. C. S. Senescence and Rejuvenation. *Journal of Physiology*, Vol. XII, pp. 97–153, 1891.

71. MIWA, NORIHIVA, M. D. A study upon weights from 3 to 80 years of age. *Tokio I-Gaku-Kwai-Zatumshi*, Vol. VII, No. 9 (May 5, 1893), Japan.

Dr. Miwa gathered data from the kindergartens, higher schools, colleges and other sources. He deals with the problem of maturity in growth, and also, to a limited extent, with the weights of different classes of society. In the tables given the number of persons examined is generally from 150 to 230 for ages between 6 and 20 years.

72. MOON, S. B. Measurements of the boys of the McDonough School, for years 1888–91. McDonough School, Maryland, 1892.

73. MOULTON D. Body Weight and Mental Improvement, *American Journal of Insanity*, October, 1894.

74. PAGLIANI. Die Entwickelung des Menschen in den der Geschlechtsreife vorangehenden späteren Kinderjahren und in Jünglingsalter von 7 bis 20 Jahren. Other publications by Pagliani are not available, except in Italian (for titles, see bibliography given by Dr. Porter, Growth of St. Louis Children). Pagliani investigated the height, weight, lung capacity and muscular force of children, boys and girls, 7 to 18 years of age, of Turin, Italy. He considered the effects of good and poor nutrition, giving tables of rate of growth of school girls under favored conditions and corresponding facts concerning a number of charity girls. He also gives statistics upon the effects of exercise upon the development of lung capacity of boys.

75. Oakland (Cal.) School Report, 1892–93. In 1892 about 6,000 children, 6 to 18 years, were weighed and measured under the direction of the University of California and Stanford University. A part of this data was collated. The study is in reprint form and gives tables and graphic charts of height and weight.

76. PECKHAM, GEO. W., M. D. The Growth of Children. Sixth

Annual Report of the State Board of Health of Wisconsin. The study was undertaken in 1881 in the public and various private schools of Milwaukee. It consists of data of about 10,000 children, from 4 to 18 years, arranged much on the same plan as that of Dr. Bowditch's study (No. 18). There are eleven plates and thirteen tables segregating the rates of growth by nationalities. Among the topics treated is that of the relative reliability of the arithmetical averages and medium values, variations of growth by influences of sex, race, climate, density of population, relation of growth of body and lower extremities.

77. PORTER, W. T. Relation of Growth of Children and their deviation from the physical type of their sex and age. Trans. Acad. Sci. of St. Louis, Vol. VI, No. 10, 1893.

78. PORTER, DR. WILLIAM TOWNSEND. Growth of St. Louis Children. Issued as a report of the Academy of Science of St. Louis, Vol. VI, No. 12, pp. 263–380. This is the result of the study of 34,354 children; 16,295 boys and 18,059 girls of St. Louis, taken in 1892. It embraces data of age, sex, occupation and nationality of parents, height standing, weight sitting, span of arms, strength of squeeze, girth, weight, measurements of face and head. The first portion of the report is occupied with a statement and discussion of the statistical methods employed and mathematical consideration of probable error, the median or average, etc. Among the many subjects treated are: The influence of occupation and nationality of parents, sexual differences of growth, application to individual children of the mean values. There are fifty-one tables largely in percentile grades and thirty-four plates illustrating graphically the facts shown by the tables. An index and a comprehensive bibliography are inserted.

79. PORTER, DR. W. TOWNSEND. The Physical Basis of Precocity and Dullness. Transactions of the Academy of Science of St. Louis, Vol. VI, No. 7, pp. 161–181. Reprint issued March 21, 1893. The conclusions of this study are derived from the date of Dr. Porter's Growth of St. Louis Children (see No. 78), and is, therefore, based upon investigations of 34,500 boys and girls, 6 to 17 or 18 years of age. The thesis he advances with much certainty is that "precocious children are heavier and dull children are lighter than the mean child of the same age." For the purpose of establishing this principle he gives fifteen tables and two plates tracing the development by age of dull, mediocre and precocious boys and girls.

80. QUETELET, A. Anthropometrie. Brussels, 1870. The data of Quetelet are inserted merely for their historic value and for reference. They have little scientific value, physiological or statistical, since they are averages from but ten individuals of each age and these were first "selected."

81. RÄTZ. Grundzüge d. Physiologie; Pathologie und Therapie des Kindesalters, 1883, p. 22 (deals with growth from birth to sixth year).

82. ROBERTS, CHARLES, F. R. C. S. Manual of Anthropometry. London, 1878. This is probably the most general and complete treatment of growth measurements in English. It deals with the methods of anthropometric study and apparatus; and contains numerous tables and an excellent bibliography up to the date of publication. Among the more important tables are those showing the height, weight, and annual rate of growth of 7,709 boys and men between the ages of 10 and 30 years of the most favored classes of the English population, public school boys, naval and military cadets, medical and university students; a similar table showing the empty chest girth of 5,915 boys and men, 12 to 30 years, of the

same class; a table showing the height, weight and chest girth of new-born infants of the artisan class; tables of actual, average and mean height, weight and chest girth of 13,931 boys and men between the ages of 4 and 50 years of the artisan class; a table from Dr. Bowditch of Boston showing the actual, mean and average weight of 10,904 American girls between 5 and 19 years; tables giving the average height and weight of 54,447 boys and men of all ages to 50 years, English population segregated according to classes as follows: professional, commercial, laboring, industrial, idiots and imbeciles, also the same data for 4,630 Boston boys from the favored class quoted from Dr. Bowditch. All of these tables segregate the data according to age. The volume also contains plates, charting certain facts given in the tables, and also one charting the relative growth from year to year of the different parts of the body, head, neck, chest, abdomen, thigh, leg and foot.

83. ROBERTS, CHARLES, F. R. C. S. Memorandum on the Medical Inspection of, and Physical Education in, Secondary Schools. Report of the Royal Commission on Secondary Education of England, Vol. V, p. 352-374. The report deals chiefly with hygiene, death rates at various ages, size in relation to intelligence, weight, height, physical education, etc.

84. RUSSOW, A. Vergleichende Beobachtungen über den Einfluss der Ernährung mit der Brust, u. d. Kunstlichen Ernährung auf das Gewicht und Wuchs (Länge) der Kinder. Jahrb. f. Kinderheilkunde, Vol. XVI, pp. 86-132, 1880-1.

85. SCHMIDT, EMIL. Die Körpergrösse und das Gewicht der Schulkinder des Kreises Saalfeld (Herzogthum Meiningen). Archiv. f. Anthropologie, Vol. XXI, pp. 385-434 (1892-93). In the city of Saalfeld on June 1, 1889, 9,506 children, 4,699 boys and 4,807 girls, from 5 to 14 years, were measured and weighed. Herr Schmidt devotes much space to comparing these heights and weights with the results of other studies, those in Freiburg, Gohlis, Posen, Breslau, Hamburg, Boston, England and Turin; a second part is taken up with a comparison of the children of Saalfeld city with those in the outlying country, data of which are given; a careful study in detail is also made of each district. The study is replete with tables.

86. SCHMIDT-MONNARD, KARL. Die chronische Kränklichkeit in unseren mittleren und höheren Schulen; XII internationalen Med. Kongress zu Moskau, 1897; also Zeitschrift f. Schulgesundheitspflege, 1897, Nos. 11 and 12, pp. 593-620, 666-685. Dr. Schmidt-Monnard has in this study made a valuable and elaborate contribution to the literature of hygiene of the middle and higher schools from data he has collected in Halle. He investigated 5,100 boys and 3,200 girls in the higher and middle schools, relative to the prevalence of chronic diseases, headache, nervousness, chlorosis, sleeplessness, indigestion, loss of appetite, nose bleed and eye troubles. He considers the problem of sex, finding boys less susceptible to disease than girls; the conditions of various classes of school, the hygiene of their requirements and the data class by class; effects of home duties; the amount of sleep at various ages, effects of fatigue observed. He gives a number of charts, and a few tables, some of which deal with effects of vacation colonies and the growth in height and weight of individual children through the 14th year.

87. SHUTTLEWORTH, DR. G. E. The Health and Physical Development of Idiots Compared with Mentally Sound Children of the Same Age. Proc. of Association of Medical Officers of American Institutions for Idiotic and Feeble-minded Persons, 1876-86, pp. 315-322.

88. SULIGOWSKI, DR. FELICYAN. (Anthropometric measurements of children in the gymnasium for boys at Radom, Russia.) Medycyna, Tome XV, p. 512. Warsaw, 1887. Dr. Suligowski gives data upon 1,133 males, 9 to 21 years of age. The investigation deals with statistics upon height, weight, expansibility of the chest, power of sight, color of hair, traces of crookedness on the breast, increase of lymphatic tonsils on the neck.

89. TARBELL, DR. G. G. On the Height, Weight and Relative Rate of Growth of Normal and Feeble-minded Children. Proceedings of the Association of Medical Officers of American Institutions for Idiotic and Feeble-minded Persons, 1876-86.

90. TOPINARD, PAUL. Etude sur la Taille, considérée suivant l'âge, le sexe, l'individu et les races.

91. TOPINARD, PAUL. Anthropology translated by R. T. H. Bartley, M. D. Philadelphia, 1878.

92. VAHL, DR. M. (Director of the Girls' School of Jägerpris in Denmark.) Mittheilungen über das Gewicht nichterwachsener Mädchen. Congrès Périodique International des Sciences Médicales, Copenhagen, 1884, pp. 120-125. The school is for poor girls. The children vary in age from 4 to 16 years. They were weighed twice a year from 1874 to 1883, on April 1 and October 1. Tables are given of the yearly and half yearly weighings, and the increases, showing a larger growth in the summer half year than in the winter half year. A brief statement of his results with table will be found in the Burgerstein-Key Hygienische Untersuchungen, pp. 244-245 (No. 58).

93. VIERORDT, K. Physiologie des Kindesalters; Gerhardt's Handbuch der Kinderkrankheiten, Bd. I, pp. 228-36.

94. VIERORDT, K. Anatomische, Physiologische und Physikalische Daten u. Tabellen.

95. VIERORDT, K. Grundriss der Physiologie des Menschen. Tübingen, 1871.

96. VILLERME. Annales d'Hygiène, Vol. I, p. 359.

97. VOIT, DR. C. Ueber die Periodicität im Gewicht der Kinder, 1885.

98. WARNER, DR. FRANCIS. Report to the British Medical Association and Charity Organization Society of London on the Physical and Mental Condition of 5,000 Children seen in 106 Schools of London. Reprinted in the Report of the Commissioner of Education (U. S.), 1890-1, Vol. II. See also Bibliography No. 109.

99. WARNER, DR. FRANCIS. Study of Children, 1897.

100. WARNER, DR. FRANCIS. A Method of Examining Children in Schools as to their Development and Brain Condition. *British Medical Journal*, Sept. 22, 1888.

101. WEST, GERALD M. Worcester School Children, the Growth of Body, Head and Face. *Science*, Vol. XXI, Jan. 6, 1893. The investigator weighed and measured 3,250 individuals, 5 to 21 years, in the public and private schools of Worcester, Mass. He gives curves (not tables) and discussion of weight, height, width of head, length of head, sitting height, index of sitting height, proportion of breadth of face to breadth of head, etc.

102. WEST, GERALD M. Anthropometrische Untersuchungen über die Schulkinder in Worcester, Mass. Archiv. f. Anthropologie, Vol. XXII, pp. 13-48, 1894. The study here detailed is a much more complete report than that given in *Science* (No. 101), though dealing with the same topics. There are given twenty-one tables and five chart curves.

103. WEST, GERALD M. Observation of the Relation of Physical Development to Intellectual Ability Made on the School Children

of Toronto, Canada. *Science*, N. S. IV, 1896, pp. 156-159. This is a preliminary report to a contribution not yet completed. The writer discusses the conclusion of Dr. Porter in St. Louis that children taller and heavier are more precocious than their lighter and shorter fellows of the same age. He reaches a diametrically opposite conclusion. The basis for determination of precocity is the teacher's judgment, while in St. Louis the basis was the school grade in comparison with age. Dr. West gives no figures, but a curve showing the relative size of "good" and "poor" students.

104. WEST, GERALD M. Address in Proceedings of the International Congress for Anthropology, Chicago, 1893.

105. WIENER, DR. CHRISTIAN. Das Wachstum des menchlichen Körpers (in Vorträge Gehalten im Naturwissenschaftlichen Verein zu Karlsruhe). Karlsruhe, 1890. This is abrief monograph giving the yearly heights and head measurements of Dr. Wiener's four sons from birth to maturity. Tables and curves are furnished and it forms a contribution of its kind of great value.

106. WINDLE, B. C. A. Anthropometric Work in the Schools. *Medical Magazine*, London, 1894, pp. 631-649.

107. WRETLIND has weighed the pupils of the girls' school in Gothenberg (Denmark) at the beginning and end of the school year (September and June). His results were printed at Eira in 1878, in Danish. A review of essential results and tables will be found in the Burgerstein-Key Schulhygienische Untersuchungen, pp. 240-242 (No. 58). Wretlind attempts to show that school work retards growth.

108. ZACHARIAS, O. Ueber Periodicität in der Gewichtzunahme bei Kindern; Monatl. Mitth. a. d. Gesamtgeb. d. Naturw. Berlin, 1889.

109. Report on the Scientific Study of the Mental and Physical Conditions of Childhood; with particular reference to children of defective constitution, and with recommendations as to education and training; based upon the examination of 50,000 children seen in 1888-91 and another 50,000 seen in 1892-4; published by the Committee. Parkes Museum, Margaret street, W., London; 1895.

# THE ENGLISH OF THE PSYCHOPHYSICAL MEASUREMENT METHODS.

By E. B. Titchener.

For some years past I have had it in mind to issue for class use a series of four-page leaflets, giving the schemata of the principal measurement methods (just noticeable stimuli, minimal changes, equivalents, mean gradations, average error, right and wrong cases) with concrete illustrations. My aim would be to subordinate mathematics to psychological analysis; to show the introspective reason for each step in each method, but to make the mathematical treatment of the results a matter of rote. The mathematical basis of the error methods might then be set forth in a separate appendix to the six leaflets, should there be any demand for it.

The carrying out of this idea has been delayed by the lack of English symbols for the exposition of the methods. In the translator's preface to Kuelpe's "Outlines of Psychology" (1895) I wrote: "Many English writers on psychophysical questions have employed the German abbreviations; there are obvious difficulties in the way of an English terminology; and it is not probable that any proposals which could be made at the present time would find general acceptance." I hoped that, if attention were thus called to a serious defect in our working apparatus, some one might come forward with suggestions for a remedy. The hope has not been fulfilled. I therefore venture to offer some suggestions of my own. I do so because I feel that leaflets of the kind just described would be of real service in my own class work, and presumably in that of other psychologists.

Sensitivity and sensible discrimination can evidently be shortened, as they have been in some of the periodical summaries in *Mind*, to *S* and *SD*. Sensation must be represented by *s*. There is then every reason to keep the German *r* as the symbol for stimulus; there can be but few students who have not come across an *r* used in this sense, and *r* comes before *s* in the order of the alphabet as stimulus before

sensation in the order of the experiment. A difference between two stimuli, any $r—r_1$, will be $D$; the just noticeable difference or difference limen $\triangle r$. The stimulus limen or just noticeable stimulus may then be termed $r_\lambda$. We thus have $r_\lambda$ as the measure of sensitivity,[1] and $\triangle r$ and $\frac{\triangle r}{r}$ as the measures of the absolute and relative $SD$ respectively. The standard stimulus I call $U$ (uniform), the stimulus of comparison $V$ (variable); so that $\frac{\triangle r}{r}$ becomes, in practice, $\frac{\triangle r}{U}$. The mean variation is $mv$, written as the case requires $mv$, $\frac{mv}{r}$, $\frac{mv}{U}$, or $\frac{mv}{D}$; the mean or average error is $me$.

Paralleling these symbols with those given by Kuelpe in his Table on pages 52, 53, we have:

| German. | English. | |
|---|---|---|
| $r, r_1, r_2, r_3, \ldots$ | $r, r_1, r_2, r_3, \ldots$ | Stimulus. |
| $\triangle r$ or $D$ or $r\text{-}r_1, \ldots$ | $D$ or $r\text{-}r_1, \ldots$ | Stimulus difference. |
| $S$ or j. n. $\triangle r$, | $\triangle r$, | Difference limen. |
| German $S$, or j. n. $r$, | $r_\lambda$, | Stimulus limen. |
| $\triangle r$, $S$, | $\triangle r$, | Abs. mag. of $SD$. |
| $\frac{\triangle r}{r}$, $\frac{S}{r}$, | $\frac{\triangle r}{r}$, | Rel. mag. of $SD$. |
| $N$, | $U$, | Standard stimulus. |
| $V$, | $V$, | Stim. of comparison. |
| $M$, | $M$, | Arithmetical mean. |
| $MV$, | $mv$, | Mean variation. |
| $\frac{MV}{r}$, | $\frac{mv}{r}$, | Rel. del. of $S$. |
| $\frac{MV}{\triangle r}$, $\frac{MV}{N}$, | $\frac{mv}{\triangle r}$, $\frac{mv}{U}$, | Rel. del. of $SD$. |
| $\breve{r}$ or $\triangle \breve{r}$, | $\breve{r}$ or $\breve{D}$, | Subliminal $r$ or $D$. |
| $\hat{r}$ or $\triangle \hat{r}$, | $\hat{r}$ or $\hat{D}$, | Supraliminal $r$ or $D$. |
| $\equiv$, | $\equiv$, | Subjective $=$. |
| $\geqq$, | $\geqq$, | Subjective $>$. |
| $\leqq$, | $\leqq$, | Subjective $<$. |
| $E$, | $S$, | Sensitivity. |
| $UE$, | $SD$, | Sensible discrimination. |

The method of just noticeable stimuli requires the further signs $r_{\lambda_o}$ and $r_{\lambda_u}$. That of minimal changes requires $\triangle r_o$, $\triangle r_u$, $r_o$, $r_u$ and their variants, together with $R$ and $\triangle$. The relation limen[2] I propose to express by $\Lambda r$; so that

[1] I use $\lambda$, and not $l$, to avoid confusion of the $l$ with the numeral 1 in printing and black-board writing.

[2] I choose $\Lambda$ as the initial letter of the Greek $\lambda\acute{o}\gamma o\varsigma$, ratio.

$\frac{r_o}{r} = \Delta r_o$, $\frac{r}{r_u} = \Delta r_u$, and $\sqrt{\Delta r_o \cdot \Delta r_u} = \sqrt{\frac{r_o}{r_u}} = \Delta r$.

The methods of equivalents and of mean gradations introduce no new expressions.

In the method of right and wrong cases we set out from a $D$ that is very little $\gtrless \Delta r$, and obtain the equation:

$$\frac{r}{n} + \frac{w}{n} + \frac{e}{n} + \frac{d}{n} = 1;$$

where $r$ is right, $w$ wrong, $e$ equal and $d$ doubtful, and $n$ denotes the number of observations. The use of $r$ in this method has bred no confusion in German statements of it, and need not do so in English.

For the error stimuli in the method of average error I use the symbol $r_\varepsilon$. We have, therefore:

$$\frac{r_{\varepsilon_1} + r_{\varepsilon_2} + r_{\varepsilon_3} \quad . \quad . \quad . \quad r_{\varepsilon_n}}{n} = R_\varepsilon.$$

The German $\Delta m$ then becomes $mv_\varepsilon$, and $\Delta m_1$ becomes $me_\varepsilon$. The English terms suggest what the values really are: the mean variation and average error of the error stimuli obtained.[1]

I subjoin Kuelpe's final Table (p. 78) and the corresponding list of English signs. The $h$ which appears in both tables is Gauss' measure of precision.

GERMAN.

| Stimulus and Difference | | | Determination | Comparison |
|---|---|---|---|---|
| *E.* | | Magnitude | German *S.* | $r \mid\mid\mid r_1$ $(E:E_1 = r_1:r)$ |
| | | Delicacy | *MV*; *MF* | *MV*; *MF* |
| *U. E.* | Mag. | Absolute | *S* | $\Delta r \mid\mid\mid \Delta r_1$ $(UE:UE_1 = \Delta r_1 : \Delta r)$ |
| | | Relative | $\frac{S}{r}$ | $\frac{\Delta r}{r}$, $\frac{\Delta r_1}{r_1}$; $r:r_1 = r_1:r_2$ |
| | Del. | Absolute | *MV*; *MF*; *h*; $\Delta m$ | *MV*; *MF* |
| | | Relative | $\frac{MV}{r}$; $\frac{MF}{r}$; $h.r$; $\frac{\Delta m}{r}$ | $\frac{MV}{r}$; $\frac{MF}{r}$; $\frac{MV}{\Delta r}$; $\frac{MF}{\Delta r}$ |

[1] For the $r_\varepsilon$ sign series I am indebted to Mr. I. M. Bentley, who has kindly revised this paper in MS. The Greek $\varepsilon$ is taken to avoid the symbol $me_e$.

ENGLISH.

| Stimulus and Difference | | | Determination | Comparison |
|---|---|---|---|---|
| *S.* | | Magnitude | $r_\lambda$ | $r \parallel\!\mid r_1$ $(S : S_1 = r_1 : r)$ |
| | | Delicacy | $mv;\ me$ | $mv;\ me$ |
| *SD.* | Mag. | Absolute | $\triangle r$ | $D \parallel\!\mid D_1$ $(SD : SD_1 = D_1 : D)$ |
| | | Relative | $\frac{\triangle r}{r}$ | $\frac{D}{r},\ \frac{D_1}{r_1};\ r : r_1 = r_1 : r_2$ |
| | Del. | Absolute | $mv;\ me;\ h;\ mv_\varepsilon,\ me_\varepsilon$ | $mv;\ me$ |
| | | Relative | $\frac{mv}{r};\ \frac{me}{r};\ h.r;\ \frac{mv_\varepsilon}{r},\ \frac{me_\varepsilon}{r}$ | $\frac{mv}{r};\ \frac{me}{r};\ \frac{mv}{D};\ \frac{me}{D}$ |

I shall greatly value any criticism of these proposals, as well as of the plan of issuing method leaflets. I shall also be glad to know whether laboratory psychologists would welcome the publication of blank sheets prepared for the recording of method work in the drill course.[1] The following, *e. g.*, shows such a sheet prepared for the method of just noticeable stimuli:

" Experimenter, Unit,
Subject, Date,
Instrument, Hour,

Series .

Initial value of $\overset{\nabla}{r}$, Size of steps, Value of $r_{\lambda_o}$,
Initial value of $\overset{\Delta}{r}$, Size of steps, Value of $r_{\lambda_u}$,

$r_\lambda =$ .

Mag. of *S* for stimuli = .

Remarks:
References."

[1] Since the sending of this paper to the printer, I have received Vol. IV of the *Yale Studies*, in which Dr. Scripture describes certain of the experiments given in his drill-course. The note-book made up by the Yale students has some points of resemblance to that which would be made up from my printed blanks; but the two differ very considerably both in method and in object. I therefore leave the above paragraphs as they were written. It may be that the near future will see the publication of a number of laboratory note-books, differing as current text-books differ. The result would be, on the whole, a distinct gain to experimental psychology; the place of the science in the undergraduate course could be better defined, and the undergraduate training of the candidate for graduate scholarships better estimated than is now possible.

Taking Kuelpe's illustration (p. 55), we can fill out the blanks thus:

Experimenter, A. B. C. Unit, 1 mgr.
Subject, X. Y. Z. Date, Jan. 27, 1898.
Instrument, Minimal Pressure Weights. Hour, 3 P. M.

Series $\overset{\vee}{r}$ to $r_\lambda$, $\overset{\wedge}{r}$ to $r_\lambda$.

Initial value of $\overset{\vee}{r}$, 1 mgr. Size of steps, 1 mgr. Value of $r_{\lambda_o}$, 4 mgr.

Initial value of $\overset{\wedge}{r}$, 9 mgr. Size of steps, 1 mgr. Value of $r_{\lambda_u}$, 6 mgr.

$r_\lambda = 5$ mgr.

Mag. of $S$ for pressure stimuli $= \frac{1}{5}$.

Remarks:

Weights were applied to tip of forefinger of right hand.

Same result was reached if the first step in each direction was made 2 mgr., and the following steps 1 mgr.

Remember to repeat the whole series, working from $\overset{\wedge}{r}$ to $r_\lambda$, and then from $\overset{\vee}{r}$ to $r_\lambda$, for the elimination of possible constant error.

Advisable to repeat both series several times; results interfered with by slipping of weights, unevenness of contact, tickling.

Notice that the *mv*, measure of delicacy, coincides with unit of instrument. To get a reliable *mv*, the unit must be made smaller.

Etc., etc. Effects of habituation, expectation, predisposition, practice, fatigue.)

References:

Kuelpe, "Outlines," p. 56.
Wundt, "Lectures," p. 50.
Etc., etc.

# MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

## XVI.—A STUDY OF CERTAIN METHODS OF DISTRACTING THE ATTENTION.

## III. DISTRACTION BY MUSICAL SOUNDS; THE EFFECT OF PITCH UPON ATTENTION.

By L. DARLINGTON, A. B., and E. B. TALBOT, A. B.

The experiments described in this paper were made during the year 1896-'97. Their main object was to determine (1) whether there is any relation between the pitch of a musical note and its effect upon the attention, and (2) whether music, when used for purposes of distraction, has any direct dynamogenic effect, and, if so, what it is. We hoped also to get (3) some general results in regard to the value of the musical phrase as a distraction. A fourth question, quite foreign to our first intention, suggested itself early in the work; and the experiments were arranged so as to bear upon it as well as upon our chief problem. The attention of the subject was tested by his discrimination of lifted weights; and the side-issue which we tried to settle was (4) the question whether upward, downward, or double movements are best for the comparative estimation of lifted weights.

The method employed was that of right and wrong cases. The details of the experiment were as follows: The subject sat sidewise at a low table, with his right fore-arm resting upon it, the ulnar side down. His eyes were closed. Above his arm, and at right angles to it, was a small iron rod, to limit the distance through which the hand should be raised or lowered. The rod was wrapped with woolen cloth in order to prevent distraction from temperature sensations. Its height above the table was 22 cm. The weights used were two wooden boxes, like enlarged port-wine glasses broken off short in the stem and lidded, about 6.5 cm. in diameter at the top, containing fine shot. For two of the subjects (*Se.* and

*P.*) the weights were 250 *g.* and 265 *g.* respectively. For the third subject (*Sh.*) they were 250 *g.* and 260 *g.*[1]

At the word 'ready,' the subject put his hand in the proper position for the experiment, with the fingers bent in so that the thumb and fore-finger formed a ring. If downward movements were to be made, the hand was raised until the volar side of the wrist touched the rod, the elbow remaining on the table. Two seconds after the signal was given, the first weight was placed in the support formed by the thumb and fore-finger, and the required movement—upward, downward, or double—was made. As soon as the movement was finished, the weight was removed from the hand. Two seconds after the completion of the movement, the second weight was given, without a signal, and the movement was repeated.

The experiments were made in series of twenty-five each, and three different 'patterns' were used.[2] In the following list, *a* indicates that the lighter weight and *b* that the heavier was given first. Each pattern, whenever used, was repeated with the letters transposed.

| First Pattern. | Second Pattern. | Third Pattern. |
|---|---|---|
| *b* | 2 *a* | 3 *b* |
| 2 *a* | 3 *b* | 2 *a* |
| 3 *b* | *a* | 2 *b* |
| 2 *a* | 2 *b* | 3 *a* |
| 2 *b* | 2 *a* | *b* |
| *a* | 2 *b* | 2 *a* |
| 2 *b* | *a* | 2 *b* |
| 3 *a* | *b* | *a* |
| *b* | 2 *a* | 3 *b* |
| *a* | 2 *b* | *a* |
| *b* | 3 *a* | 2 *b* |
| 2 *a* | *b* | 3 *a* |
| 3 *b* | 2 *a* | |
| *a* | *b* | |
| 25 | 25 | 25 |

The distraction consisted of twenty-five phrases, of nine notes each, played upon the piano. All were written in $\frac{2}{4}$ time and in the key of C.[3] Five different octaves were used,

[1] We had assumed that a difference of 10 *g.* (*i. e.*, of $\frac{1}{15}$) would be supraliminal; but preliminary experiments showed that for *Se.* and *P.* a larger difference was necessary.

[2] *Phil. Stud.*, XI, 224.

[3] The following is No. 3 of the set of 'phrases,' some of which we adopted from G. Viehl's "Graded Studies in Sight Singing" (1896), while others we put together ourselves :

the notes ranging from the $c^{-1}$ to the $c^{4}$. In each series of twenty-five experiments, five phrases were played in each octave. The order of the phrases was changed with each series, and no exercise was played twice in the same series. The succession of the octaves was so arranged that each occupied any given position (*e. g.*, the first) just as often as every other octave. Moreover, it was very seldom (only once in ten series) that any octave followed the one just above or below it on the piano.[1]

Experiments were made with three subjects: Miss S. E. Sharp (*Sh.*), Miss N. G. Seymour (*Se.*) and Dr. W. B. Pillsbury (*P.*). All were trained subjects. *P.* was 'unmusical'; *Sh.* averagely, and *Se.* exceptionally 'musical'. There were four classes of experiments:

I. Without distraction.
II. With distraction throughout the experiment.
III. With distraction in the first half.
IV. With distraction in the last half.

The four classes are referred to by Roman numerals throughout this paper.

In I, 600 experiments were made by *Se.* (200 for each of the three movements) and 450 by *Sh.* and *P.* In II, III and IV, *P.* performed 500, and *Se.* and *Sh.* 750 in each class. This gave *Se.* and *Sh.* 250 experiments for each of the three movements in each set, while *P.* had either 150 or 175 for each movement of each set.[2] Or, if we estimate according to octaves, in each class *P.* performed 100 experiments and *Se.* and *Sh.* 150 for each octave. The movement and the class of experiments were varied frequently, so as to insure equal degrees of practice in all.

The following Tables (A to D) give the results of our experiments so far as they have a bearing upon the question of *distraction*. In each of these tables, the double, upward and downward movements are averaged. The figures indicate the percentages of right judgments.[3]

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[1] In order to secure this result and the still more important one of equal distribution of the octaves, it was necessary that the number of series taken should be some multiple of ten; *e. g.*, when double movements were used, each subject had to make either 250 experiments, or 500, or 750, and so on.

[2] This inequality is due to the fact that, as explained above, we could not use more than 500 experiments in any class, unless we had time to make as many as 750.

[3] These percentages are obtained in the usual way; $r^{1} = r + \frac{e}{2}$. *P.* and *Se.* gave exceedingly few *e* judgments from the first. *Sh.* gave more; but the number rapidly decreased with practice. It does not seem necessary, for our present purpose, to print the full tale of *r*, *w* and *e*.

TABLE A.
(Class II.)

| SUBJECT. | Octave I. | Octave II. | Octave III. | Octave IV. | Octave V. | Average. | No Distraction. |
|---|---|---|---|---|---|---|---|
| *Se.* | 81 | 75 | 72 | 84 | 80 | 78 | 73 |
| *P.* | 75 | 81 | 72 | 80 | 73 | 76 | 74 |
| *Sh.* | 74 | 78 | 72 | 76 | 69 | 74 | 71 |

TABLE B.
(Class III.)

| SUBJECT. | Octave I. | Octave II. | Octave III. | Octave IV. | Octave V. | Average. | No Distraction. |
|---|---|---|---|---|---|---|---|
| *Se.* | 79 | 81 | 73 | 73 | 77 | 77 | 73 |
| *P.* | 84 | 75 | 74 | 84 | 79 | 79 | 74 |
| *Sh.* | 63 | 66 | 74 | 72 | 64 | 68 | 71 |

TABLE C.
(Class IV.)

| SUBJECT. | Octave I. | Octave II. | Octave III. | Octave IV. | Octave V. | Average. | No Distraction. |
|---|---|---|---|---|---|---|---|
| *Se.* | 85 | 85 | 81 | 79 | 79 | 82 | 73 |
| *P.* | 73 | 77 | 71 | 83 | 82 | 77 | 74 |
| *Sh.* | 76 | 67 | 76 | 74 | 69 | 72 | 71 |

TABLE D.
(Average of II, III and IV.)

| SUBJECT. | Octave I. | Octave II. | Octave III. | Octave IV. | Octave V. | Average. | No Distraction. |
|---|---|---|---|---|---|---|---|
| *Se.* | 82 | 80 | 75 | 79 | 79 | 79 | 73 |
| *P.* | 77 | 78 | 72 | 82 | 78 | 77 | 74 |
| *Sh.* | 71 | 70 | 74 | 74 | 67 | 71 | 71 |

In the light of these results we may consider the questions (1) whether music furnishes an adequate *distraction* and (2) whether the effect produced by it has any constant relation to *pitch*. Of our four Tables, A furnishes the safest basis for an answer to the first question. For it might well be that in II the music would have a different effect from that which it exercised in III and IV. If we give the music only in one-half of the experiment, we may be simply 'distracting' through that half, and not affecting the other half at all; or we may be altering the whole experiment. In the latter case two opposite results are possible. The music may facilitate the attention, by sharpening the contrast between the two parts of the experiment; or it may confuse the subject, and thus inhibit the attention. And in a case where the music facilitates in II, it may very well have the opposite effect in III and IV. Hence if the different Tables suggest different conclusions, we should give more weight to the testimony of A than to that of B and C, or even of D.

With *Se.* and *P.*, however, the conclusions drawn from all four Tables are the same; viz., that *in general the music facilitates* rather than inhibits the attention; though for *Se.* one case (octave) in fifteen, and for *P.* four in fifteen, show the opposite result. With *Sh.*, on the contrary, Table C shows a deviation from this rule which is sufficient to affect the average results (in D). If, however, we base our judgment upon the results of Table A, we see that for *Sh.* also, the general effect of the music is that of facilitation, though in one octave it slightly inhibits. We conclude, then, that for these three subjects music throughout the experiment facilitates the attention, and that music in one-half has the same effect five times in six; *i. e.*, in all the sets except *Sh.'s* III. Whether, in general, music in one-half helps *more* than music throughout the experiment, the figures do not show conclusively. With *P.*, the facilitation is greater in III and IV than in II; with *Se.*, it is greater in IV and less in III; while with *Sh.*, it is less in IV and gives place to inhibition in III.

We turn now to the second question. M. Féré concluded from the results of his experiments that the dynamogenic effect of a musical note is greatest in the middle octaves.[1] If

[1] Ch. Féré, "Sensation et Mouvement," Paris, 1897, esp. p. 35. Féré worked with single clangs, not with phrases; and warns his readers against confusing the direct dynamogenic effect of the note with the associative influence of the 'morceau' (p. 38). Our phrases, however, did not suggest a musical air, *i. e.*, were not associative. Hence the results of the two investigations are largely comparable. Again, Féré's curve (p. 35) appears to have been taken from a 'hypnotique.' But he distinctly says that the results obtained with

we grant this hypothesis for a moment, the question is at once suggested whether the effect upon attention follows the same law or the opposite one; *i. e.*, whether the middle octaves have the greater effect upon attention—either in the way of facilitation or of inhibition—or whether they have the smaller effect. There does not seem to be any reason for supposing *a priori* that the psychological effect should follow the same law as the physiological. And when we examine the Tables we cannot find conclusive testimony in favor of either alternative. *If there is any fixed relation*, however, it seems probable from these results that *the middle octaves have the greater effect upon attention.* If we leave *Sh.'s* results out of account for the present, we notice in those of *Se.* and *P.* (1) that in all but one of the eight cases (four for each subject) the middle octave shows the lowest percentages; and (2) that in four of the seven cases in which it is lowest its percentage falls below that of no-distraction, in two it is equal to that of no-distraction, and is higher in but one. Since there is so great a tendency for the percentages of the middle octave to fall below that of no-distraction, while yet the average results for the five octaves are in every case better than that for no-distraction, we cannot adopt the theory that the middle octave has the least effect upon consciousness. We must rather suppose that it has an effect so great that the point of maximal facilitation has been already passed and inhibition has set in. In some cases, the inhibition produces a sudden falling of the attention-curve below the line of no-distraction; *e. g.*, in *P.'s* results in A and D, we find the highest points represented in Octaves 2 and 4, while in Octave 3 the curve falls below the no-distraction line. This seems to show that the point of highest facilitation is immediately succeeded, not by a smaller degree of facilitation, but by actual inhibition. On the other hand, in *Se.'s* C and D, we have, after the maximal point in Octave 2, a lessening of facilitation which does not amount to inhibition. Of these eight cases, five (*i. e.*, all but *P.'s* A and C and *Se.'s* C) seem, when taken separately, to support the theory that the middle octaves have the greater effect upon consciousness: *e. g.*, in *P.'s* D, Octave 1 shows facilitation; Octave 2, slightly greater facilitation; Octave 3, inhibition; Octave 4, facilitation; and Octave 5, diminished facilitation. When we compare the five cases with one another, however, we find some discrepancies; *e. g.*, in *Se.'s* A

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neuropathic and hysterical subjects differ only in degree from those gained with normal subjects (pp. 32, 33). Dr. Scripture's curve ("Thinking, Feeling, Doing," p. 86) is evidently a copy of Féré's, generalized and translated from *kg.* into *lbs.* *Cf.* the figures on pp. 87, 88 with Féré, pp. 37, 38, 43, 49.

and D the points of maximal facilitation seem to be in Octaves 1 and 4, while in her B they are in Octaves 2 and 5. We notice, also, two cases, viz., *P.'s* A and C, where one end of the attention-curve falls below the line of no-distraction. When we turn to *Sh.'s* results, we find even greater difficulties for the theory. Her figures in A exemplify it fairly well; but those of C and D are difficult to explain, while those of B directly contradict the theory. According to the results of B, the middle octaves affect consciousness least; for we have facilitation in Octaves 3 and 4, and inhibition in Octaves 1, 2 and 5. In the face of so much contradiction we must give up the attempt to deduce from our results any clear-cut relation between pitch and the effect upon the attention, although the indications are undoubtedly as stated above.

Table E shows the bearing of our results upon the question of *dynamogenesis*. As explained above, *a* indicates that the lighter and *b* that the heavier weight was given first. The first two rows of figures in each set (*e. g.*, III *a* and III *b*) give the percentages of right judgments for *a* and *b* respectively. In the rows marked *Diff.*, we have the amount by which the *a*-judgments are better than the *b*-judgments. In the rows marked Per cent., we have the percentage obtained by dividing this difference by the percentage of the *a*-judgments.

If the music has a dynamogenic effect, the fact should appear from an examination of the Table. Since there is a general tendency toward over-estimation of the second weight (time error), we should expect to find in I and II, as we do, a higher percentage of right judgments in *a* than in *b*. Now if the music, by bracing the muscles, makes the weights appear lighter, then in III, where the music is played only during the first half of the experiment, the difference between the *a* and the *b* judgments should be greater than in I and II. In IV, on the contrary, the music, which is played only in the second half, should counteract, either wholly or in part, the tendency to over-estimate the second weight. Consequently, the superiority of *a*-judgments over *b*-judgments should be either lessened or entirely destroyed—or, possibly, even changed to a superiority of *b* over *a*. Moreover, if M. Féré is right in maintaining that the dynamogenic effect is greater in the middle octaves, these results should be more apparent in Octave 3 than in Octaves 1 and 5.

Let us consider first whether there is any general dynamogenic effect. On the whole, it looks as if there were. For *P.*, the difference between *a* and *b* is, on the average, somewhat greater in III than in either I or II, though in some octaves this is not the case; while in IV it is, on

TABLE E.

| SUBJECT. | | Octave I. | Octave II. | Octave III. | Octave IV. | Octave V. | Aver-age. | No-Dis-tract'n |
|---|---|---|---|---|---|---|---|---|
| Se. | II *a* | 84 | 79 | 77 | 87 | 84 | 82 | 83 |
| | II *b* | 77 | 73 | 68 | 79 | 77 | 75 | 62 |
| | Diff. | 7 | 6 | 9 | 8 | 7 | 7 | 21 |
| | Per cent. | 8.3 | 7.6 | 11.7 | 9.3 | 8.3 | 8.5 | 25.3 |
| | III *a* | 86 | 84 | 77 | 80 | 84 | 82 | 83 |
| | III *b* | 73 | 78 | 69 | 65 | 70 | 71 | 62 |
| | Diff. | 13 | 6 | 8 | 15 | 14 | 11 | 21 |
| | Per cent. | 15.1 | 7.1 | 10.4 | 18.8 | 16.7 | 13.4 | 25.3 |
| | IV *a* | 93 | 90 | 82 | 83 | 85 | 87 | 83 |
| | IV *b* | 78 | 81 | 79 | 75 | 73 | 77 | 62 |
| | Diff. | 15 | 9 | 3 | 8 | 12 | 10 | 21 |
| | Per cent. | 16.1 | 10 | 3.7 | 9.6 | 14.1 | 11.4 | 25.3 |
| P. | II *a* | 90 | 86 | 73 | 83 | 76 | 82 | 81 |
| | II *b* | 60 | 77 | 71 | 75 | 68 | 70 | 68 |
| | Diff. | 30 | 9 | 2 | 8 | 8 | 12 | 13 |
| | Per cent. | 33.3 | 10.5 | 2.7 | 9.6 | 10.5 | 14.6 | 16 |
| | III *a* | 93 | 81 | 86 | 90 | 85 | 87 | 81 |
| | III *b* | 75 | 68 | 63 | 77 | 73 | 71 | 68 |
| | Diff. | 18 | 13 | 23 | 13 | 12 | 16 | 13 |
| | Per cent. | 19.4 | 16 | 26.7 | 14.4 | 14.1 | 18.4 | 16 |
| | IV *a* | 72 | 77 | 76 | 88 | 85 | 80 | 81 |
| | IV *b* | 74 | 77 | 66 | 77 | 79 | 75 | 68 |
| | Diff. | 2 | 0 | 10 | 11 | 6 | 5 | 13 |
| | Per cent. | 2.8 | 0 | 13.2 | 12.5 | 7.1 | 6.3 | 16 |
| Sh. | II *a* | 79 | 83 | 75 | 85 | 79 | 80 | 81 |
| | II *b* | 69 | 73 | 68 | 67 | 59 | 67 | 61 |
| | Diff. | 10 | 10 | 7 | 18 | 20 | 13 | 20 |
| | Per cent. | 12.7 | 12 | 9.3 | 21.2 | 25.3 | 16.3 | 24.7 |
| | III *a* | 76 | 79 | 87 | 81 | 78 | 80 | 81 |
| | III *b* | 50 | 54 | 63 | 62 | 50 | 56 | 61 |
| | Diff. | 26 | 25 | 24 | 19 | 28 | 24 | 20 |
| | Per cent. | 34.2 | 31.6 | 27.6 | 23.5 | 35.9 | 30 | 24.7 |
| | IV *a* | 75 | 69 | 78 | 80 | 67 | 74 | 81 |
| | IV *b* | 77 | 64 | 75 | 69 | 71 | 71 | 61 |
| | Diff. | –2 | 5 | 3 | 11 | –4 | 3 | 20 |
| | Per cent. | –2.7 | 7.2 | 3.8 | 13.8 | –6 | 4.1 | 24.7 |

the whole, much less than in I and II. With *Sh.* this result is even more marked. For every octave, we find the differ-

ence greater in III and less in IV than it is in I and II. In two octaves of IV, we even see the relation of *a* and *b* reversed: the *b*-judgments are somewhat better than the *a*-judgments. *Se.'s* results are less easy to explain. In III the difference is greater than in II, but less than in I; similarly, in IV it is less than in I, but somewhat greater than in II. We notice a fact, however, which may help to explain this discrepancy. For *Se.*, the difference between *a* and *b* is much less in II than it is in I. It is possible, then, that the general effect of the music may be to decrease the difference between *a* and *b* judgments. The reason for this is, perhaps, that the music, by acting as a facilitation, helps to keep the first weight in memory until the second is given. The first weight 'loses' less, in the interval between the two parts of the experiment, and thus the tendency toward over-estimation of the second weight is partly counterbalanced. If we grant this hypothesis, it may help us to reconcile *Se.'s* results with the theory that *P.'s* and *Sh.'s* suggest. In III, the working of the law of dynamogenesis would tend to make the difference between *a* and *b* greater than it is in I; but the facilitation in the first part of the experiment helps to counteract this effect; hence the difference is less than it is in I, though still somewhat greater than in II. In IV, since the music is played only in the second half of the experiment, it does not have this effect. Here we have nothing but dynamogenesis to counteract the tendency toward over-estimation of the second weight; and if we assume that the second factor is more important, we can understand why the difference between *a* and *b* in IV is so much larger than we had expected.

Table F may serve to bring this point out more clearly. The figures are taken from the last two columns of the rows marked Per cent. in Table E.

TABLE F.

| CLASS. | Favoring *a*. | Favoring *b*. | Per cent. of Difference in Favor of *a*. | | |
|---|---|---|---|---|---|
| | | | *Se.* | *P.* | *Sh.* |
| I | Time-error | | 25.3 | 16 | 24.7 |
| II | Time-error | Facilitation | 8.5 | 14.6 | 16.3 |
| III | Time-error<br>Dynamogenesis | Facilitation | 13.4 | 18.4 | 30 |
| IV | Time-error | Dynamogenesis | 11.4 | 6.3 | 4.1 |

If one can draw any conclusion from these results, it is that in *Se.'s* case facilitation is a more important element than dynamogenesis in determining the relative accuracy of *a* and *b* judgments in III and IV; while for *Sh.* and *P.* dynamogenesis is the more prominent factor. We have no desire to assert that these results *prove* anything; but they seem to hint at the presence of a dynamogenic law, and also to indicate that a 'distraction' which acts as a facilitation will, if given with the first of two stimuli, partly counteract the tendency to underestimate it. That this counteraction is especially marked in *Se.'s* case may be due to the fact that she has had a very exceptional musical training.

We may now turn to the question whether or not the dynamogenic effect is shown most strongly *in the middle octaves.* If it is, the difference between *a* and *b* will be greater in III and less in IV for the middle octaves than for the others. For *Se.*, this relation is not found in III; while the fourth octave has the greatest difference, the second and third have the least. In IV, on the other hand, *Se.'s* percentage for the third octave seems to support Féré's theory; but the value of its testimony is lessened when we remember that, in order to explain *Se.'s* average results in IV, we had to assume that dynamogenesis has comparatively little effect with her. If

TABLE G.

| SUBJECT. | MOVEMENT. | CLASS. | | | | AVERAGE. |
|---|---|---|---|---|---|---|
| | | I. | II. | III. | IV. | |
| *Se.* | Double | 78 | 84 | 82 | 83 | 82 |
| | Up | 74 | 77 | 77 | 82 | 78 |
| | Down | 67 | 74 | 71 | 81 | 73 |
| *P.* | Double | 77 | 77 | 84 | 81 | 80 |
| | Up | 70 | 78 | 75 | 77 | 75 |
| | Down | 75 | 73 | 78 | 77 | 75 |
| *Sh.* | Double | 75 | 72 | 68 | 73 | 72 |
| | Up | 68 | 77 | 68 | 71 | 71 |
| | Down | 70 | 72 | 68 | 72 | 71 |

this is the case, it is difficult to understand the suddenness of the descent from Octaves 2 and 4 to Octave 3.[1] With *P.*, the difference in III is greatest for the third octave, as it should be; but unfortunately it is also greatest for this octave in IV. Moreover, the second octave in III presents a difficulty. With *Sh.*, in III, the third and fourth octaves show the least differences instead of the greatest; while in IV, the percentage of the third octave, though less than that of Octaves 2 and 4, is greater than that of Octaves 1 and 5. On the whole, then, *it does not seem that we can assert any essential relation between pitch and dynamogenic effect.*

Our last table, G, is designed to show which is the best movement for estimating lifted weights. The figures indicate percentages of right judgments. In getting the figures in the column marked *Average*, due account was taken of the fact that fewer experiments were made in I than in II, III or IV.

From these results it appears that *double movements* are uniformly best for *Se.*, are best for *P.* in three cases in four, and are, on the whole, slightly best for *Sh.* For *Se.* upward movements are better than downward, while for *P.* and *Sh.* the two movements are about equally good. If we look at promptitude and subjective certainty of judgment, we must put the double movement a little ahead of the upward, the upward very considerably ahead of the downward. Hence the curves of magnitude and delicacy of *SD* show the same general trend, but do not run strictly parallel (*cf.* Külpe, "Outlines," p. 50).

There were certain defects in our method of experimentation which, with more foresight, might have been avoided; and it may be well to mention them here. (1) Each series consisted of twenty-five experiments, or five in each octave. This gave in any particular octave a predominance of either *a's* or *b's;* and since several different 'patterns' were used, we found, when we came to average our results, that some octaves had more *a's* than *b's*, and others more *b's* than *a's*. Since *a*-judgments tend to be better than *b*-judgments, this introduced an error into the figures of Tables A–D. The amount of the error was computed, and it was found that in seven of the seventy-two cases in those Tables a correction of 1% was required. The correction is included in the figures as given. In no case does it alter the relations of any two octaves. The error might have been avoided if we had used

[1] It is interesting to notice that *Se.'s* IV is the sole case of the six that furnishes a good illustration for Féré's theory. Taken by itself, it is excellent evidence for the theory: it is only when we compare it with the other results of the same subject that it fails.

series of thirty experiments, and had arranged the patterns so that in each series the number of *a's* and *b's* in any octave would be equal. Our reason for not using a series of fifty experiments was that we found upon trial that the subject became fatigued before the series was finished. (2) The attempt to solve the problem of double, upward and downward movements in connection with our main question was probably unwise, since, as we have seen, it greatly limited the number of experiments that could be used. We were led to it by the consideration of its possible theoretical importance (*cf.* Miss Parrish's experiments, this JOURNAL, VIII, pp. 51, 52). (3) The order in which the phrases were played was varied, so that the subject might not expect any particular phrase at any time. No attempt was made, however, to arrange the succession in such a way that each phrase would occur in one octave as many times as in another. This would have been somewhat difficult, since the order of octaves was also changed with every series. Still, if we were to repeat the investigation, we should try to remove this possible source of error.

We may sum up the results of our investigation in the following points:

(1) In general, the effect of the music was to *facilitate attention*, both when it was played throughout the experiment and when it was played in one-half only. In other words, under the conditions in which we used it, the music did *not serve as a true distraction.*

(2) There is some evidence, though it is not conclusive, of a dynamogenic law operative in III and IV.

(3) There is no evidence of any constant relation between pitch and dynamogenic effect, and hardly any of such a relation between pitch and 'distracting' power.

(4) It seems probable that a slight distraction, given with the first of two stimuli that are to be compared, will counteract to some extent the tendency toward over-estimation of the second stimulus (time error).

(5) For the comparative estimation of lifted weights, double movements appear to be somewhat better than single (either upward or downward) movements.

## POSTSCRIPT.

The three Studies, XII, XIV and XVI, were undertaken with the view of discovering a means of distraction that should be capable of gradation, uniform in its working and

applicable to normal subjects. With such a distraction it would be possible, on the qualitative side, to describe the attributes of mental processes given in the state of inattention, and, on the quantitative, to measure the magnitude and delicacy of sensitivity and sensible discrimination in the same state.

Unfortunately, the work done upon the question had to be divided up into three parts, each to be completed within a year. Although we foresaw that such work would necessarily prove incomplete and, so far, unsatisfactory, we still judged the attempt at a solution of the problem to be worth the making. Now that it is finished we have, at least, and apart from any positive results, done something toward clearing the ground for future investigators. As for the results themselves, they may be summarized as follows:

(1) The use of a stimulus as a distraction does not by any means guarantee distraction. The 'distracting' stimulus may, in reality, reinforce or facilitate the attention.

(2) Many stimulus complexes are inherently unsuited to act as distractors. Among them are addition and similar arithmetical exercises, spelling, translating, etc., and musical phrases.[1]

(3) It must not be assumed that the effect of a distraction is limited to that part of the experiment which it accompanies. The attention may be given to or abstracted from the experiment as a whole; and distraction during a part of the experiment may affect the attention to the whole. This fact very greatly complicates the distraction problem.

(4) The most promising distractors are those that appeal most directly to affection, the obverse of attention; the least promising are those that appeal solely to the 'intellect,' and themselves demand active attention.[2] Odors have proved capable of furnishing a satisfactory distraction series.

(5) When one goes behind the numerical results and enquires into the mental mechanism of distraction, one is at once introduced into the field of individual psychology. It is, therefore, probable that the requirement which we set ourselves to fulfill is, in its strict formulation, impossible of ful-

[1] Some of these may, perhaps, be utilized in the future under the conditions laid down by Miss Hamlin: this JOURNAL, VIII, p. 62.

[2] So, too, Miss Hamlin: "When the addition was performed while there was any strong affective coloring of the subject's consciousness, it was usually a successful means of distraction." JOURNAL, VIII, p. 62; and Dr. Daniels: "The reading of interesting stories in a loud voice and with the greatest possible rapidity" proved a useful mode of distracting. Note that the loudness and the interest are both appeals to the passive attention, and that the rapidity secures some sort of continuity. JOURNAL, VI, p. 559.

filment. 'Uniformity of working' is, it would seem, not to be secured.[1]

In conclusion, we would remind the reader that these results are valid only under the conditions of our experiments. There are many fields, both of sense discrimination and of distraction, which we have not touched at all. It is quite possible that some of the presuppositions of our work are wrong; psychologists are not by any means at one in regard to the significance of the results obtained by the method of right and wrong cases, the meaning of the time error, etc. It is greatly to be hoped that in the near future the whole issue may be raised more thoroughly than we have been able to raise it.

E. B. T.

[1]Hence I should avoid any such distractors as stories, musical airs, etc. They will distract, if they arouse associated ideas, and so possess an affective value; but the confusion of individual psychology becomes thereby worse confounded.

# THE REPRESENTATION OF TINTS AND SHADES OF COLORS BY MEANS OF ROTATING DISCS.

By A. KIRSCHMANN.

In a former article of this JOURNAL I gave, on the basis of a mathematical deduction, directions for the construction of discs which show, when in rotation, all saturation degrees of a color-tone with exclusion of differences in intensity (AM. JOURN. OF PSY., Vol. VII, p. 386 ff.).[1] It may sometimes

[1] I am sorry to state that by some mistake of the printers, the formulæ which I gave in that paper were distorted almost beyond recognition. I obtained afterwards a number of copies of the article, in which the necessary corrections had been made, but I was not able to provide every reader of the JOURNAL with a copy. Only those who got the corrected offprint can make anything out of the analytic representation of the constructions. For the sake of those who have only the number of the JOURNAL in hand, I may append here the corrected formulæ, page 398 ff.:

The conditions to be satisfied are that the saturation begins at a certain distance $d$ from the centre to decrease in such a way that the length of the radius $r$ and the arc of the corresponding angular value of the color-component, $\phi$, are inversely proportional; or:

When $r = d$, $\phi = 180°$;
" $r = a + d$, $\phi = 180 - \varepsilon$;
" $r = na + d$, $\phi = 180 - n\varepsilon$;

from which follows the equation of the curve

$$\phi = 180 - (r - d)\frac{\varepsilon}{a};$$

and if we put $\frac{\varepsilon}{a} = \mu$,

$$\phi = 180 - (r - d)\,\mu. \quad (1)$$

The value of $\mu$ is dependent on the size of the disc. If we wish to have the saturation 0 at the distance $R$ from the centre, we must satisfy the special condition that

$$\phi = 0, \text{ when } r = R.$$

The above stated equation (1) takes, then, the form

$$\mu\,(R - d) = 180,$$

$$\text{or } \mu = \frac{180}{R - d}.$$

be desirable to produce all *tints* and *shades* of a color-tone, *i. e.*, all the transitions from white to the fully saturated color and from this to black, on one surface. In case we desire a continuous change in a simple arithmetical progression, this can be accomplished by a disc of the nature of that in Fig. 1, the simple construction of which scarcely requires any explanation. The inner part (I in our figure) is the very same as part A in Fig. 2 of the earlier article, and the outer part (III in our figure) is bounded by the continuation of the same common spirals, whose equation with reference to polar-coördinates could be derived as follows:

Let us call $d$ the distance from the centre from which we wish to start, and $R$ the radius of the disc, whilst the variables whose interdependence we are to express by the equation, *i. e.*, the radius at any place of the disc and the angular distance of the curve from the first radius may be denoted by $r$

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If we substitute this value for $\mu$ in the equation of the curve, we have

$$\phi = 180 - \frac{r-d}{R-d}\,180,$$

$$\text{or } \phi = 180\left(1 - \frac{r-d}{R-d}\right) \quad (2)$$

We have to determine now the equation for the curve which divides the remainder of the disc into a white and a black part. Suppose the intensity of the color was equal to that of a gray composed of $n^\circ$ white and $m^\circ$ black. The ratio of the white sector to the whole surface left by the color, then, will be $\frac{n}{n+m}$. And since the angular value of the whole uncolored surface must at any distance from the centre be $180^\circ - \phi$, the angular value of the white always will be

$$(180^\circ - \phi)\,\frac{n}{n+m};$$

or if we substitute the above stated value for $\phi$,

$$\frac{180\,(r-d)}{R-d} \cdot \frac{n+m}{n}. \qquad (3)$$

In order to eliminate possible errors introduced by the spatial arrangement, it will be advisable to carry out each series of experiment with two discs, the one with the above stated arrangement, the other with the saturation increasing from the centre to the periphery. In this case the equations, corresponding to the above stated (2) and (3), read as follows:

$$\phi = \frac{180\,(r-d)}{R-r},$$

and the angular value of the white sector, the width of which is now decreasing from the centre to the periphery, can be expressed thus:

$$180\left(1 - \frac{r-d}{R-d}\right) \cdot \frac{n}{m+n}.$$

and $\varphi$ respectively. The conditions to be satisfied by the equation, then, are:

$$\begin{aligned} &\text{When } r = d,\ \varphi = o;\\ &\text{“ } r = \chi + d,\ \varphi = y;\\ &\text{“ } r = n\chi + d,\ \varphi = ny; \quad (1)\\ &\text{and in addition, “ } r = R,\ \varphi = 360°. \end{aligned}$$

From the third of these conditions it follows that

$$n = \frac{r - d}{\chi}.$$

If we substitute this value for $n$ in the second part of the above statement (1), we have

$$\varphi = \frac{r - d}{\chi} y.$$

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If we wish to have an increase of the intensity in a geometrical progression from the centre to the circumference, the following conditions have to be satisfied:

$$\begin{aligned} &\text{When } r = a,\ \phi = \varepsilon;\\ &\text{when } r = na,\ \phi = \varepsilon^n; \end{aligned}$$

$$\text{from which follows that } \phi = \varepsilon^{\frac{r}{a}}, \quad (1)$$

$$\text{or } r = a \frac{\log \phi}{\log \varepsilon}. \quad (2)$$

In order to take into account the desired size of the disc, *i. e.*, in order to give $\varphi$ a determined value $X$ at a certain distance from the centre, we have to satisfy the condition that

$$r = R, \text{ when } \phi = X,$$

where $R$ is the desired radius of the disc.

$$\text{We have, then, } X = \varepsilon^{\frac{R}{a}},$$

$$\text{or } \log X = \frac{R \log \varepsilon}{a},$$

$$\text{from which follows } \frac{a}{\log \varepsilon} = \frac{R}{\log X}.$$

If we substitute this value for $\frac{a}{\log \varepsilon}$ in the equations (1) and (2), we obtain

$$r = \frac{R \log \phi}{\log X},$$

$$\text{and } \phi = \sqrt[R]{X}. \quad (3)$$

If, on the other hand, a decrease of intensity from the centre is desired, a deduction similar to that above stated leads from the

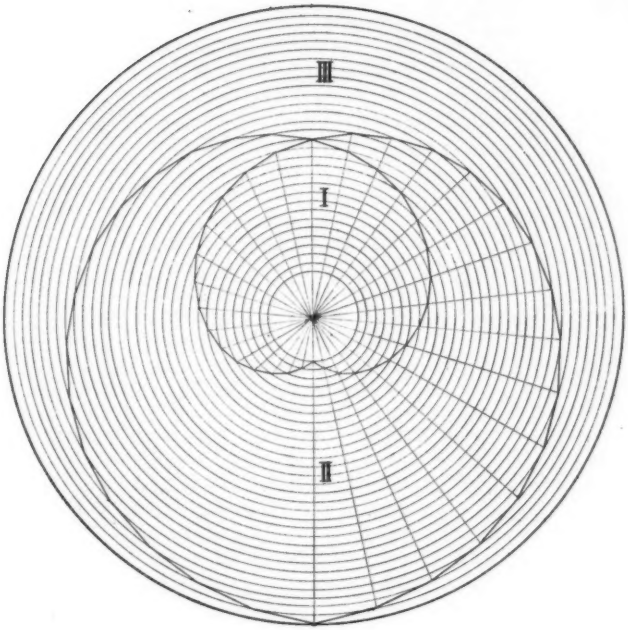


FIG. 1.

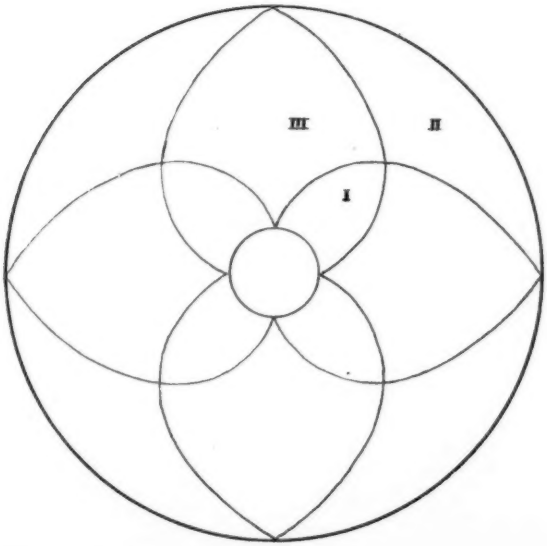


FIG. 2.

Let $\frac{y}{x}$ be called $\mu$, then we have

$$\varphi = (r - d)\,\mu. \qquad (2)$$

In order to eliminate $\mu$, which must be expressed in terms of $d$ and $R$, we apply the formula just stated to the fourth of the conditions above. It reads, then,

$$360° = (R - d)\,\mu;$$

$$\text{or} \quad \mu = \frac{360°}{R - d}.$$

Substituting this value in our equation for the curve (2), we obtain

$$\varphi = \frac{(r - d)\,360°}{R - d}. \qquad (3)$$

In practically applying the above results we have to cover part I of the disc with white, part II with black (black velvet), whilst part III has to be occupied by the color whose tints and shades we wish to produce. A disc of this construction will, when in rotation, show from the centre to the middle of the radius all tints from white to the full saturation of the pigment applied, and from these to the periphery all shades from full saturation to black in continuous transition. Similarly, a disc with black at part I and white at part II will show the very same in opposite order.

In order to facilitate the blending of the components, it may be recommended that the construction should be applied, not for the whole disc, but, perhaps, for each third or quarter of it. Fig. 2 gives the appearance of a disc, which has the above construction for each quadrant.

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condition: when $r = na$, $\phi = \sqrt[n]{\varepsilon}$ to the equation

$$\phi = \sqrt[r]{X^R}, \qquad (4)$$

where $R$ denotes, as above, the radius of the disc and $X$ the desired angular value of the white at the circumference.

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When $r = na$, $k\,\phi + (180 - \phi) = \varepsilon^n$,
or $\phi\,(k - 1) + 180 = \varepsilon^n$,

which, treated as in the simpler case above, leads to the equation

$$\phi\,(k - 1) + 180 = \sqrt[R]{[X\,(k - 1) + 180]^r},$$

$$\text{or } \phi = \frac{\sqrt[R]{[X\,(k-1) + 180]^r} - 180}{k - 1}.$$

It will easily be seen that, if a logarithmic increase and decrease is desired, the formulæ according to which the disc in Fig. 7 of the former publication is constructed, *i. e.*,

$$\varphi = \sqrt[r]{X} \quad \text{and} \quad \varphi = \sqrt[R]{X^r}$$

require only little modification to adapt them to the present purpose.

It may be mentioned, also, that the above described construction may be utilized for demonstrating the totality of possible mixtures between a certain color-tone and a pair of complementary colors; *e. g.*, if we wish to have the transition from yellow to its complementary, violet, not through grey, but through red, we have to cover part III of the above disc with red, and parts I and II with yellow and violet (or *vice versa*) respectively.

# SOME ASPECTS OF THE EARLY SENSE OF SELF.

G. Stanley Hall.

In January, 1895, I printed and circulated a questionnaire (Series 1, No. VII), requesting returns on children's sense of self, to which I have now received 523 replies, upon which this report is based. Nearly all are made by teachers, and about four-fifths are collected by instructors of psychology from their pupils. Some observed a year, some two, and a very few three years, before sending in their papers, some of which were almost treatises, of great interest and instructiveness to me, and many had little or no value. In addition to these data, Mr. Street of this university has kindly permitted me to utilize 387 returns he has collected upon early ideas of the soul. Besides these sources, there have been data from probably several score of miscellaneous, incidental and uncounted papers, so that nearly a thousand persons are here represented.

I. The earliest parts of the physical self to attract attention are the hands and fingers. Sixty-four babies, mostly between two and six months of age, are reported to have examined their hands curiously, and a few showed fear when they were first noticed. Sometimes a hand would be stared at steadily, perhaps with growing intensity, until interest reached such a pitch that a grasping movement followed, as if the infant tried by an automatic action of the motor hand to grasp the visual hand, and it was switched out of the centre of vision and lost as if it had magically vanished. It is the hand in motion, however, that seems first to attract the eye. Some describe an expression of surprise as the hands are moving with an unusual vigor which suddenly arrests attention for an instant, as if the eye first asked, "What are these moving white objects that are so hard to catch or follow?" The mouth has known the hand long before the eye, which first regards it as it would a new toy. It seems probable from the data that the hands know each other, in a sense which Schopenhauer thought so important a stage in self-conscience, before the eye knows them. Children of four and five months are described as attentively feeling of one hand with the other, each at the same time feeling and being felt, each subject and object to the other, and thus detaching them from the world

of external things and labeling them with a mark which will enable the soul later to incorporate them into the plexus which forms the somatic ego. The hands are stroked, grasped by each other, watched as if they belonged to another, held up and gazed at, studied and compared; one is placed in, beside, upon the other, moved and followed by the eye, held still and moved as if to get the optical effect, and hands of other children, and in one or two cases even other objects, are mistaken for their own. Some curious accounts are given of the hands having gotten under or behind the body, up the sleeve or under the clothes, and thus being lost, while the infant seems to search for them as if with growing apprehension. Sometimes this stage is prolonged. A girl of nine months loved to sit at table, apparently chiefly to play with her hands, and another habitually preferred to use her bottle to study her hands upon rather than to drink from it.

Before and after about twelve months of age, the fingers attract great attention. They are interlaced, rolled, each touched, as if in counting (and it is not irrelevant here to reflect on the enormous amount of tallying and counting that prevailed for unknown ages before mathematical symbols and simple rules have so eliminated it that it is rarely seen save in the strange recrudescence of arithmomania), and far more rarely and later each placed against the corresponding one of the other hand. They are pulled, bitten, bent, twisted, and, of course, often persistently sucked, sometimes up to and even into school age. A boy of one year old is said to often pick up his fingers one by one, another of fifteen months to feel of each successively. A girl of two years struck her hand for pulling down a vase; and another, of the same age, pinched her own fingers because they had pinched the baby. A girl of thirty months angrily beat her fingers for tearing a tidy, but said, as is very common, that she did not do it, but her fingers did. Little girls often scold their fingers. These kinds of apostrophe are probably often an imitation of the way parents whip hands that do wrong, but it is interesting that it persists and so many say *e. g.*, "Naughty hands, you always make me bad," or, "You took the cake," "picked the plums," "broke the glass," etc. A girl of three was overheard talking to her hands, which were restless and twitchy. "Why can't you keep still, as mamma (meaning herself) wants you to?" Two girls of three bit their fingers, one till it bled, "to see if it was really me." Besides older finger plays, like piggy, children often invent plays, as of hands and feet going to visit each other, particularly if two children are in bed. Children of three, and even five, sometimes count and recount their own fingers to see if they are all there, and those of

other people to see if they have the same number they have, or the same number on both hands.

Gynecologists tell us that the hand may "find" the mouth before birth. When this occurs it would seem more likely to have significance for the nascency of external physical self-consciousness than when hands or feet touch each other or other parts of the body, because the mouth, which is a psychic focus to which everything goes to be tested in early infancy, is more sensitive. Hence to one devoted to a Fichtean dogmatism it might be said that when hand and mouth meet, body consciousness begins. If Berkeley is right concerning the incommensurability of visibilia and tangibilia, the infant gazing at and feeling its hands is, even at this tender age, committing the unpardonable psychological sin from which weary terms of epistemology in junior and senior year, under the best masters, can never wholly cleanse the soul. Even if full purgation of soul on this point be achieved, and then the adept should chance in some moment of revery to bite his visual finger, he would, at least for a painful instant, backslide to feel that it was a part of the "real me" of touch. Each hand is a subject-object to the other as their mutual acquaintance progresses, and as right-handedness develops, perhaps the left hand is more subjective and the right more objective. At any rate, the right is more prone to trespass across the bilateral plane into the left's domain, and will be always honored and preferred, and the left neglected, so that this equilibrium between subjective and objective that seems so promising is soon hopelessly upset. The eye, however, intervenes just in time, and when the hands could no longer be thesis and antithesis to each other, sublates them to a new synthesis in the higher visual consciousness, which is the truth of the old mouth knowledge of them. Whereas they were projects, they are now ejects of whatever mind the infant has, and he faintly but pathetically anticipates the adult insight of their nouminal unreality as mere objective phenomena when he "finds them lost." We have thus already the mouth-hands, the hand-hands and the eye-hands, at least, to say nothing whatever of other tactile body hands as the corner-stones of the ego. Each doubtless involves its own centres, although we do not yet know the precise number, tract or cortical location of af- and ef-ferent fibres, and will not now pause to draw even a schematic diagram of their actions, or describe the slowly growing association fibres which knit them later into will-idea hand centres, because the brain is so complex that any schemata that any of our readers may habitually use will probably be as correct as their favorite number forms, phonisms or photisms. We desire, however, to invite investigation by

those more competent than we to what seem the more important philosophical points involved, viz.: In the first contact of hand and mouth does the latter feel the former first and most, or *vice versa;* does the eye first find the hand because the eye moves, or because the head moves, and does a motor or a sensory process lead? What social and ethical factors are involved in the child's scolding and punishing naughty hands? What symbolic interpretation of the child's many as yet unscheduled finger-plays would be most consonant with the philosophy of Fröbel? And finally, will the purely abstract and deductive metaphysical psychologist tell us whether, so far, we have instinct, feeling, will, reason, attention, or mere automatism? for all that follows is, of course, utterly worthless until described at least in terms of adult consciousness, if not in those of standard metaphysical system.

A special period of "noticing" the feet comes somewhat later than that in which the hands are discovered to consciousness. Our records afford nearly twice as many cases for feet as for hands. The former are more remote from the primary psychic focus or position,[1] and are also more often covered, so that the sight of them is a more marked and exceptional event. Some children become greatly excited whenever their feet are exposed, and especially whenever the foot gear is removed. Some infants show signs of fear at the movement of their own knees or feet covered, and still more often fright is the first sensation which signalizes the child's discovery of its feet. As with the hands, it is often their motion which first attracts attention, and they sometimes, by sudden involuntary movement, leave the field of view and become lost. Being farther away, their vertical and lateral movements subtend to a smaller angle, but they vanish easier at the bottom of the field of view because hidden by the body, clothes, etc. Infants of five to eight months who have found their feet are often described as seeking them with more or less aimless efforts, which are, however, purposive enough to reveal their intent. Later the child acquires the power to seize its feet with its hands, then to lift or kick off the clothes, and still later to remove its stockings to get at the new playthings. Many are described as playing with them as if fascinated by strange, newly-discovered toys. They pick them up and try to throw them away, or out of the cradle, or bring them to the mouth, where all things tend to go. Then comes the stage of toe-sucking, which sometimes as early as three months becomes persistent and troublesome.

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[1] See my "Notes on the Study of Infants," *Pedagogical Seminary*, Vol. I, p. 130.

In our record of sixteen marked cases eleven are with the left toe. The same experience of biting, as with the hands, often occurs, and the child perhaps cries with the pain many times before it really associates the bite and the ache. Sometimes this association seems to be marked by a distinct series of experiments, and some children old enough to talk express this newly-made experience by saying, "I bite and you hurt," or, "It aches when I bite." Our protocol contains the word "examine" twenty-seven times and "watch" thirty-three times to describe this special direction of attention. Children often handle their feet, pat and stroke them, offer them toys and the bottle, as if they, too, had an independent hunger to gratify an ego of their own.

The toes are a still more specialized class of playthings which are plucked and pulled, sometimes with signs of surprise that they cannot be played with like a rattle. Later yet comes the record of foot and toe movements made for the eye, marking probably the time when these motor impulses are associated with retinal impressions. Before the age of one year, children take pleasure in games with the mother or nurse which involve giving names of animals, etc., to each toe, as they do earlier with the fingers. Various foot games are often made a distinct event which is regularly expected at bed-time, in the morning, or at bath. Children often develop at this time a special interest in the feet of others, and examine, feel of them, etc., sometimes expressing surprise that the pinch of the mother's toe hurts her and not the child, or comparing their own and the feet of others point by point. Curious, too, are the intensifications of foot-consciousness throughout the early years of childhood whenever children have the exceptional privilege of going barefoot, or have new shoes. The feet are often apostrophized, punished, beaten sometimes to the point of pain for breaking things, throwing the child down, etc. Several children have habits, which reach great intensity and then vanish, of touching or tickling the feet, with gales of laughter, and a few are described as showing an almost morbid reluctance to wear anything upon the feet, or even to having them touched by others, so that they must perhaps be washed by force or strategy. The common habit of lying upon the back and tramping the soles against a vertical wall, as if to anticipate walking, seems sometimes to have a period of special intensification. Three babies, otherwise normal, used their toes for grasping playthings and block-building so exclusively that they had to be coerced to use their hands instead. Others acquire the trick of rubbing the feet together with expressions of great glee, as older people rub the hands together. Several almost fell in

love with the great toe or the little one, especially admiring some crease or dimple in it, dressing it in some rag of silk or bit of ribbon, or cut off glove fingers, winding it with string, prolonging it by tying on bits of wood. Stroking the feet of others, especially if they are shapely, often becomes almost a passion with young children, and several adults confess a survival of the same impulse which it is an exquisite pleasure to gratify. The interest of some mothers in babies' toes, the expressions of which are ecstatic and almost incredible, is a factor of great importance. On the whole one cannot read these plain and homely data without querying whether some of these exacerbations of this group of experiences may be laying some of the psycho-physical foundations for the foot fetichisms which may later appear in degenerates after the dawn of sexual maturity.

Twenty-three returns show that infants of thirteen to fifteen months of age sometimes have a special period of being interested in their own knees, and one society of school girls adopted the custom of wearing rings on the toes as their distinctive badge. Throwing or pulling both toes and fingers out of joint and making them crack is a frequent fad of school life.

Next in order comes acquaintance with the ear. Some infants of only three or four months of age develop troublesome habits of pulling their own ears, perhaps while nursing; others pull and sometimes scratch them repeatedly till they cry and the ear bleeds. Several children of six to ten months cannot sleep without feeling their own ear; three want it folded up and tucked into the meatus; four cannot nurse without feeling the mother's ear; a few form the habit of seizing all ears within reach, or, perhaps more particularly, those of the cat or dog. Some form of this habit often persists for years. A girl of four incessantly feels of her ears, each with both hands, fearing they may be lost. Children occasionally suffer from fears, probably often suggested, of almost morbid intensity and often of years' duration, lest their ears are growing too large or small, or taking on the shape of those of an animal, or may become hard or bone-like, or droop like a wet rag. A girl of eleven has a veritable passion for pulling, feeling, or touching her own ears and those of her friends. Four young ladies of high school age confess to a fad for ears; are chiefly interested in that organ in all strangers, get impressions of character from its shape or color. Some state that nothing could overcome the effect of bad ears for their affections. Some wish to feel the ears of all their friends. Some children persistently shake the head like a dog to feel the ears move, or try to cultivate the power of moving them

with the scalp muscles like the horse. Others incessantly pull them out or turn them toward the front at night, that they may stand out from the head, or else stretch and flatten them, or pull the lower part down, and every one has enjoyed stopping the ears and opening them with the hands, perhaps alternately. This, of course, only occurs after the child has learned, or it may mark, the first consciousness that hearing is associated with the ear. Children often think they hear with eyes, feet, or hands. Many children have a strong impulse to push everything possible into the ear, from which habit, as physicians know, dangerous results may follow. On the other hand there are often fears almost of morbid intensity lest some insect should penetrate the ears, or perhaps the devil's darning-needle pass in at one and through the head out of the other. The specific noise hunger often comes before it is associated with the ear, and as it is well known prompts infants often to pound things and make a din which is distracting for adults.

The nose in many children, although less often than the ear, has a more or less marked advent in infantile consciousness, and some children exhibit a very distinct period of interest in it. Although it is rarely large enough to be grasped, it is felt and with marked signs of curiosity, and sometimes pulled and rubbed by the child in an investigating way. The familiar adult trick of pretending to pull it off may account for the fears of some children that it may be lost. Children often try to make it longer or shorter. One permanently deformed her nose by pressing and pounding it against the head-board of her bed so it should not turn up. The nostrils often excite distinct attention, but in this respect, as well as in the propensity to explore with the fingers or stuff things into them, are not unlike the ear. From our far too meager data it would appear that the average age when children learn to associate sensations of smell with its organ is about three months. Then they begin consciously and ostentatiously to sniff and smell, and sometimes to explore the nostrils.

The hand is known or sensed by the mouth, the other hand and the eye; the foot by the hand and eye, and very little by the other foot; the ear by the hand only; and the eye is known by no other sense save very slightly by touch, and is the last as well as the highest sense to become objectified.

The first object to hold the wandering gaze of the newborn child is its mother's eye. The eyes are throughout early childhood the centres of chief fascination, so that it is strange that children often know almost nothing of their own eyes. Many children from three to five months think that their own eyes, unlike those of others, are always closed because they

find them so when touched, and some describe it as a misfortune or deformity that they are doomed to see by squinting with difficulty through the lids, so that when the mirror is seen and understood there is often surprise to find they are open. Many children spend much time before a glass studying their own eyes, and develop a fad for examining the color or watching the movements of the eye-balls and lids of other people. Whether it is the motion, the glitter of the reflected light, or the concentric arrangement of iris and pupil, it is hard to determine, but interest in eyes is so primitive and strong as to suggest the need of further special consideration of this point. Infants have often an instinctive propensity to thrust their fingers into other people's eyes, either to feel of them or to see them shut. The bright point reflected from the ball is often thought to be an agent in seeing, which is sometimes thought to be but emitted light. Yet children often become discriminative of large or small, prominent or depressed, but particularly sharp and fixed or rolling eyes. Pictures sometimes have to be removed from nurseries and kindergartens because the eyes haunt sensitive children. The eye seems to be one of the very first media along with touch through which the child comes into rapport with the parent; even older children always gaze at the eye rather than the mouth of others and take at first far more meaning from it than they gather from words. They are very susceptible to eyebrows, expression around the eyes, and generally fear big or glass eyes. When consciousness has once grappled with the eye it is often felt, pressed, rubbed the lids sometimes manipulated, and the child almost seems to be studying pressure-phosphenes, when it is probably intent only upon learning the pain threshold for all these manipulations. It may well be doubted whether Socrates, if he could have done what he claimed to be able to do, viz., turn his prominent eyes inward till each gazed full into the other across the narrow bridge of his nose, would have added to his self-consciousness thereby; but children are often persistently prone to squint the eyes inward, gaze at the point of their nose, eyebrows, hair or tongue until in positive danger of becoming cross-eyed. This, however, is only one of the many eye-gymnastics of childhood. The eyes are zigzagged vertically and horizontally rolled up and down to the extreme limits, gyrated and winking habits almost to the point of nystagmus are formed. The eyes are alternately closed and opened, and several children in our returns take pleasure in attempting to go for hours, and even days, with one eye partly or wholly closed, and sometimes both, in imiation of blindness. Eye affectations would form almost a

chapter by themselves; the modes of casting them down or up, making eyes, looking coyly askance or glancing quickly, trying to make them snap, flash, shine and reflect all the fluctuating moods and whims of juvenile instability of soul, are well known. The eyes, perhaps even more than the hands, feet and mouth, seem to be the centre of that kind of self-consciousness which is always mindful of how the self appears to others, and what to do with the eyes in the presence of strangers is a more difficult problem at the awkward age than what to do with the hands and feet. Finally must be mentioned the very common impression of young children that if the eyes are covered or closed they cannot be seen. Some think the entire body thus vanishes from sight of others, some that head also ceases to be visible, and a still higher form of this curious psychoses is that when they are closed the soul cannot be seen.

The hair is a special object of interest with infants, which begins often in the latter part of the first year, and depends much upon its abundance. Infants must learn also that a too drastic treatment of this part of their personality causes pain. In very early infancy the propensity to clutch the hair or beard of adults and, especially having grasped it, to cling with almost convulsive intensity, suggests the obvious atavistic relation to the necessity for anthropoids of arboreal habit to cling to the shaggy sides of their parents. Some deliberately try to pull it out. One cannot doubt from these returns that many, if not most, children have a distinct period of first noticing the hair, and that it may be for days or weeks an object of prominent interest. It is clutched and pulled, stroked, and more often persistently rubbed, occasionally till it is worn off at some favorite and accessible point. Some develop, perhaps from the pain of combing out snarls, a morbid horror of having it touched, which may become of convulsive intensity. Some children take pleasure in stroking or "pooring" it, especially when they feel happy, or are good or praised, and pull it madly when in anger. When it is long enough it is often chewed, sucked, bitten off, and three cases are described of children who have shown a marked propensity to pull out their hair as if by some trace of the atavistic instinct which has caused the depilation of the human body. The hair, no doubt, gives quite unique tactile sensations, both in its own roots and to hands, and is plastic and yielding to the motor sense, so that the earliest interest may be akin to that in fur, which is a marked object in infant experience. Some children develop an almost fetichistic propensity to pull or later to stroke the hair or beard of every one with whom they come in contact; but it is not until well

into the second year that the average child develops rudiments of pleasure in or even consciousness of the coiffure.

Teeth are sometimes a terrible object to infants, like big eyes, but like all feared objects there is later a special interest in them as fear is gradually overcome. When the first teeth appear, there is, of course, great sensitiveness in the gums, but also distinct interest. The propensity to bite everything is at first a blind instinct in the service of the process of cutting through the gums; but when a few teeth appear there is a revival of the early mouth consciousness and everything is bitten as everything used to be sucked. The first teeth may cause as much perturbation of consciousness as the first trousers or boots. Children may incorporate in their prayers thanks to the good Lord for giving them teeth. They are felt of and sometimes shown, and their imprint is occasionally left not only upon objects, but upon the persons of others as well as upon themselves. Sometimes children bite their own flesh severely, as if they did not realize how much more effective their jaws have become. There is a long list of cases of children who have bitten each other, or even toys in anger at this stage, suggesting that along with the teeth there is also growing the strong psychic disposition to use them as primitive animals do theirs. Children sometimes come to be particularly observant of the teeth of other children, and these, like the eyes and other organs, may become very important in mediating likes and dislikes, especially toward adults. The mouths of their parents are explored, and perhaps their own teeth studied in a mirror. When the milk teeth loosen and are removed and others take their place, there is great interest in the general subject of teeth, and there are sometimes volleys and batteries of questions concerning the teeth of animals and insects, God, etc. Teeth with gold fillings are often an object of great interest or admiration.

Less prominent than any of the above in our returns are a few other miscellaneous parts. It is surprising to see how small and late is the attention given to sex. While in several cases apparently morbid these organs early assume great prominence in consciousness, and sometimes even vicious propensities occur in the first year, the normal child sees and cares little about them. Questions are often asked, but receive answers which easily satisfy the curiosity and minimize interest. Sixty-three girls expected when they were older to be boys, and fourteen boys to be girls. This change, however, involved no thought of organs, but mainly only of dress. Almost the same might be said of navel and nipples. While a brief chapter could be written upon the consciousness of these parts, it would be largely morbid and, though

full of psychological interest, is aside from our purpose here. The act and products of excretions by bladder and bowels is often an object of interest hardly less intense for a time than eating and drinking, and many scatalogical rites of savages are suggested as paralleled by acts which cannot be recorded here.

The tongue is a magnet for the attention of young children, and it is often felt of, pulled, protruded, made into all shapes, and used for various clicks and noises. Some children develop acute fears of swallowing the tongue or losing it. It is curious to note the literalism displayed by some who, having heard the epithets especially applied to it, fear it will cut or bite, and attempt to punish it for insubordination, or later for lying. A boy of four, severely censured for untruth, was seen pulling at his tongue with the purpose of tearing it out, and succeeded in drawing blood. Tongue-touching is a game, and children often challenge each other to touch icy, nauseous or other substances to it. Some children insist on licking the cheeks, necks, hands of those they wish to caress; having cats, dogs, horses and cows lick their face. The disposition to lap, not only solid objects of food but also liquids, is persistent in some children, and not a few have a special period of interest in seeing and occasionally feeling the tongues of other children and even of animals: to have the smallest tongue is sometimes a desideratum among groups of little girls, whose form of speech may be influenced by this affectation. When tongue consciousness is at its height children sometimes affect peculiar positions of it and may press the tongue between the slightly opened teeth in smiling, or give it other positions that affect the facial expression in a laugh. Tongues certainly differ much in mobility, and in some children they can be made to assume a great and surprising variety of positions. Closely connected, too, are the early forms of voice consciousness, when every quality of tone is made, high and low, loud and soft, aspirate and vocal, clicks, gutturals, prolonged and staccato, tremulo and steady imitations of sounds of notes, wind, cars, cries of all animals and of babies.

The nails of toes, and particularly fingers, are attended to not uniformly, but at times much accented in consciousness, and there may be great dread of having them cut or even examined. They are gazed at, felt of, pulled, bitten, and some children develop a strange propensity for scratching. Occasionally this propensity is directed toward most objects of touch and is a part of the exploration of the objects of the environment. Things are not known when seen and touched alone, but must be scratched. The sensations thus given are unique, and are a class by themselves. A German medical

writer has advised that the finger-nails of children should be kept not so long that bacteria can accumulate under them, but not so short but that these sensations can have due development. The propensity to scratch faces in anger is in some children intense and cat-like, so that it becomes imperative to have special care of their nails, to avoid danger. Several girls in our returns develop a sensitiveness, which is probably morbid, against the least roughness of the nail-tips which give them symptoms akin to horripilation, and one child had a morbid propensity, sometimes seen in insanity and anæsthesia, to thrust slivers and other small objects under the nails.

Many cases of special attention to miscellaneous parts of the body were noted. Some children show a special consciousness of their shoulders, chin, the size and form of their mouth, the ankle, wrist, neck, and any defect or abnormality is certain to be the seat of acute self-consciousness. Perhaps the propensity of making faces is one aspect of growing self-consciousness, and if so, the disposition to twist and distort every joint into extreme positions, both actively and passively, no doubt helps on this development.

In fine the ego may be first roughly conceived as all that is within the skin, and the non-ego as all outside it. Many subtle, unanswerable questions have been asked, what parts of the cell are vital and active and what are passive, dead, or products of decomposition; when is food completely assimilated and really a part of the physical ego? In a sense all we own is part of the psychic ego, but in a sense food that is swallowed has only entered a tube that passes through the physical self, and is as objective to it as if applied to an external surface. The infant has to learn by slow steps the contours of his personality; beginning with the more mobile parts, the trunk is least and last known, and children are well on toward school age before they have a definite conception of the unseen and especially of the unfelt parts of the body, as witness the frequent neglect of boys to care for the hair on the back of the head. Drawings which always represent the head and limbs, then perhaps fingers and toes, and last the body, are thus a fair index of this progress.

II. Within the surface, the child's somatic consciousness does not at first penetrate. The skin is often pinched, pulled, scratched and otherwise explored; but is never thought of as a continuous limiting surface, at first, but later such questions as, "Could I jump out of it and another get in?" "Would it fit, stretch, shrink?" etc. "How could I get out of it?" "How would I look?" etc., are common. Much washing and rubbing develop the dermal consciousness, and in several

returns even itching and scratching provoke special attention to the skin. Children often take much satisfaction in stroking and "pooring" themselves and other persons, and if nervous acquire extreme sensitiveness to any degree of roughness. The most marked dermal impressions throughout childhood are thermal.

At the age of from 3 to 5 the bones are generally noticed, and there are many questions concerning the hard things under the skin. Some think them wood, iron, stone, etc. On learning that they are bone there are many flitting fears, sometimes that they will break or that dogs or other animals who love bones will eat them, or again that they have a horrid skeleton inside them, and there are many curious forms of weird bone fancies and scores of questions as to their purpose, material, size and shape. Often the knee-pan is the first bone in our returns to become an object of special interest; next comes the elbow, and then the wrist and joints. Bones are generally the first and for a time the chief object of curiosity within the body, and the discovery that cats and dogs have bones is often an event, and their size is often vastly magnified, and their shape curiously discussed.

Next comes the stomach. Its sensations of plethora and often pain, its associations with food and drink, are early. Many children believe that the entire internal body save the bones is a receptacle for food, and that it fills arms and legs, so that if the skin were anywhere cut, food would be found to be the stuffing. Some believe it hardens directly into bone. Often whims concerning appetite have affiliations with the weirdest kind of ideas of the alimentary tract. Many children conceive of the body as stuffed with saw-dust or with cotton like a pin-cushion, or with dust of which man was made, or else sweepings. On pricking or injuring the skin and seeing blood, many form the idea, often no doubt from inadequate answers to their questions, that the entire body is a skin or bag filled with blood and if it is tapped blood will gush out and the body collapse like a balloon. They often notice the pulsations of the heart and think some one is pounding inside them, and may even develop a definite image of how the man looks and how he strikes. Few organs inside the body excite so much curiosity as the heart, but the questions show that this is in large part due to its association with life and the soul, which is often identified with it even in form. Upon noticing the activity of respiration children almost always begin to experiment; they exhale all the residual breath possible and inhale a maximal amount, breathe as fast as possible and as slow, experiment with costal and abdominal modes, and particularly hold the breath often in

rivalry with each other, the higher centres thus learning control of the reflex apparatus. Very many, too, are the questions—"Why do we breathe?" "Do animals, plants, God, etc., breathe?" "What is breath?" There are many morbid fears lest respiration should accidentally stop, and many children resolve to lie awake to prevent this calamity. At this time the claustraphobias may take their rise, and there develops unusual dread of being hugged, choked, smothered in close places, being shut into closets, trunks, etc. Some have for a long time the conception that the body is a bag of wind, and some children are panic-stricken on seeing their breath on a frosty morning, thinking the soul is escaping. Perhaps there was some truth in the antique conception that dreams objectified this function, and when in nightmare we seem to flutter and hover, it is the lungs which play the stimulating rôle and suggest the thought of wings.

It is a revelation of great significance if this inward direction of thought has been aroused to learn what the country boy finds out on butchering day. Such experiences, although slight and without demonstration, cause a great and wholesome readjustment of this aspect of self-consciousness by showing both the nature and the relation of the parts within. The two most frequent questions throughout are, first, "Why have I stomach, eyes, hands?" etc., or a question seeking purpose and use; and secondly; "Have other human beings or animals the same organs?" And to realize that parents, playmates, or dog, horse and cow have legs, eyes, teeth, ears, stomach and heart as they have, always excites interest and pleasure. No child, of course, has all these experiences in the foreground of its consciousness, but all have some, and doubtless pass through, some more and some less consciously, all these phases, the definite order of most of which still remains to be determined. The internal sensations and conceptions are, as we shall see later, those most intimately associated with childish conceptions of the soul.

III. The third element in the child's consciousness, but not usually included as a factor of the ego, but which must not be neglected, and on which our returns are voluminous, is dress and adornment. Rings for fingers or ears, shoes and gloves attract the child's attention to the part involved, and a change of dress often involves change of disposition, and almost character. During the second year this is often strongly developed. Corresponding perhaps to the prominent position of the foot in the infantile consciousness, a new pair of shoes seems quite as important as a new dress. Far later, too, gloves come into great prominence. Very striking with young

children is the charm of some single and perhaps small feature, as, *e. g.*, a pair of shoes with buckles, stockings with clocks, jacket with bright buttons, a hat with a feather, a bit of fur here or ribbon there, a sash with buckle. So, too, the first pocket, the first trousers, suspenders, long pants or dress, first watch, parasol, muff, gloves, ring, necklace, standing collar, perfumery, new ways of wearing the hair, the first belt, breastpin, veil,—all these stand out in memory in the most vivid way, and have played an important rôle in the education of self-consciousness. The passion to have new things noticed, which often makes children so ridiculous, seems sometimes strongest to strangers and sometimes towards friends. This seems to mark an important moral distinction. For most girls all new articles of dress and ornament become doubly dear if liked or admired by those they know and love best, and lose their charm if the latter do not care for them.

Lotze rather curiously thought he had done for personal adornment a service comparable to what Kepler had done for astronomy by his three laws, in which he believed he had explained man's satisfaction in dress. If we touch an object with a stick, we instinctively analyze our sensations into those felt by contact of the hand with the stick, and ascribe the rest to the object at the other end of it. It gives us thus a peculiar pleasure when consciousness runs through all that touches us, and this we feel in those articles of attire that lengthen the body by prolongations of our personality at the head or feet—high shoes, stilts, hats, head-dress, etc. He thinks that all these forms of feeling change with every change of their height and form, which shifts the centre of gravity, and there is special satisfaction when equilibrium is the least trifle in danger. We feel the wind or our own motions by very different sensations in hats that are high, broad, obliquely placed, or heavy. Secondly, all hanging, fluttering or swinging garments, by their change of tension in different directions, cause us to feel ourselves most agreeably in the peripheral tract or graceful curves of their free moving ends: a trail dragging along the earth is like a new organ, endowing us with a new sense. Rings, ribbons, ear-rings, watches, sashes and everything that hangs and dangles are worn especially by the young, not so much for display as to gratify the exquisite pressure sense so peculiar to them and which, according to the modern fashions, free, flowing hair no longer does. Lastly the impressions we derive from our own clothing and its strength, stiffness or thickness our self-feeling imputes to the form or poise of our own body. The pressure of a corset, Lotze thinks, awakens the feeling of a stronger and

more elastic existence; so girdles, bracelets, and above all the first pair of trousers with suspenders gives a pleasing sense of sturdy inflexibility, and uprightness. If this view is correct it follows that we admire the folds of a graceful, well-fitting garment, not for its beauty, but that we unconsciously reproduce in ourselves the agreeable sensation of the wearer's body. So the false arm or leg half deceives even the wearer as to the boundaries of his own corporeal existence.

This view is very extreme. The great pleasure in wearing new and beautiful objects of attire in childhood is to secure thereby the attention and interest of others. Our returns abound in accounts of children who display and protrude new articles of dress, or call attention to them in the most vain and laughable way. Moreover the fact that even children will wear thin clothes when heavy ones would be far more comfortable, shoes that are too small for the sake of looks, and garments that are uncomfortably tight or thin in places, shows the dominance of those functions which Lotze disregards. The chief question is, and especially with girls, not how attire feels, but how it looks, and this standpoint dominates often in those garments that are not seen. The child who is habitually well dressed learns to avoid acts and environments which tend to soil his clothes and may become dainty, finical, fastidious and effeminate. The child who is rudely and poorly dressed, on the other hand, comes in closer contact with the world about him and acquires a knowledge more real and substantial. It is difficult to determine which pleasure is the greater, that of habitually well dressed children when very exceptionally allowed to put on old garments that cannot be injured and to strip head and feet and abandon themselves to the natural freedom thus given, or of very poorly clad children who by some good fortune are provided with attire that enables them to feel the great luxury of being well dressed. Children sometimes develop an insistent impulse to strip off parts of and occasionally all of their clothing, partly from sheer discomfort. Pants as usually made are an unphysiological and unhygienic garment, and much might be said in favor of a more rational dress for hips and thighs. There are cases of persistent denudations in childhood that are morbid and atavistic. Of the three functions of clothes, protection, ornament and Lotzean self-feeling, we must, I think, conclude that while the first is more important, the last is most infrequent and the second by far the most conspicuous in childhood. Many mention a corroding kind of self-pity with which they regard an old garment after it has been superseded by a newer and better

one, and others preserve for themselves and later for their children all the articles of the dress of childhood and infancy, and regard them later with feelings curiously described, and no doubt still more curiously mingled. That, however, man's primitive body consciousness has been largely disguised and translated into clothes-consciousness, there can be no doubt. The comfort of clean garments, sensitiveness to texture and thickness, flexibility and fit are elements which are no doubt always present, and Lotze has done a real service in showing us that clothes are an integral part of our self-consciousness. The love of wearing the dress of adults may be interpreted thus, but clothes are at best alter ego and also in part mask and distort the primal sense of the physical self. Cleanliness of body like clean dress has a prodigious moral effect on children, who change manners, temper, conduct, and put on a better self after being well washed. A wise application of clothes—psychology can do very much in rightly poising a child at the golden mean between too much and too little self-consciousness if not between excessive shyness and over-boldness.

IV. The mirror is a factor of great importance in this connection, for to it childhood owes a far more definite and visual image of its own form, feature, attire, acts, etc. It enables man, as primitive reflections in water did not, to see himself as others see him, and along with photography has given to self-consciousness a far more detailed objective and real form. The images thus seen are not like shadows and dimmer reflections thought to be soul-like, but are like the real physical self. We owe to this source a more exact and abiding impression of whether we are beautiful or ugly in feature, contour, complexion or action, and can rank ourselves more impartially in comparison with others. This knowledge may act as fatalistic discouragement or be the basis of a rank conceit; but its presence is an element of great importance. Many children inquire concerning their own beauty or attractiveness, feature by feature, of mother and mates, and it must be admitted that no true mirror or photographic plate is proof against the effects of flattery. Young children, if held before the glass when angry or crying, often change to laughter. Many hold long conversations with their reflection, addressing themselves in the second person. Some correspondents regret the invention of the mirror, but more think every one should occasionally study his own features, complexion, smile, gait, bow and other common acts, or insist that all should habitually see their entire figure behind, as well as before, in order to know self better, both for their own sake and that of their friends.

V. The names by which children are known are a factor of consequence in the early sense of self.

In response to the request to write every designation applied to children, not omitting the silliest effusions of maternal tenderness, 780 different terms were received. Of these 54 were usually applied with the prefix little, 14 with the prefix old, 5 with young, 13 with mamma's and 9 with papa's. The majority of these appellations appeared only once, but some were repeated many times. The favorite epithet was Pet, which was returned 52 times; then come Darling 49 times, Baby 41, Honey 31, Sweetheart 31, Sweetness 30, Kid 27, Sugar-plum 23, Brat, Dumpling, Tootsy-Wootsy, each 20; Bub 19, Sissy 16, Angel and Ducky, each 15; Birdy, Chatterbox, Puss, Pudding, Chicken, each 13; Precious and Dolly, each 12; Rascal and Popsy-Wopsy, each 10; Daisy, Fatty, Kittie, each 9; Lamb and Sonny, each 8; Jewel, Girlie, Bibbie, Dearie, Sunbeam, each 7; Monkey, Mischief, Midget, Rosebud, each 6; Sweetmeat 5, Bunnie, Dicky, Curly-head, Cry-baby, Nuisance, each 4; etc.

Among the pet names applied to babies those of animals are very common. They are called ape, monkey, coon, kid, pig, Billy and Nanny goat, kittie, puss, pup, rat, calf, mouse, titmouse, dormouse, cow, horsie, chipmunk, salamander, turtle, lamb and lambkin, periwinkle, pollywog, mink, oyster, crab, goosie, chick, dove, duck, cuckoo, tomtit, robin, bobolink, chickadee, pigeon, blackbird, crow, jaybird.

Names from the vegetable kingdom are common, such as apple-blossom, apple-dumpling, apple-core, apple-cart, sweet apple, pippin, peach, turnip, hazel, comfrey, pumpkin, strawberry, bud, blossom, pink, daisy, honeysuckle, tulip, buttercup, poppy, dandelion, sun-flower, peony, heartsease, beanstalk, chickweed, bluebell, harebell, Mayflower, peep-o'-day.

Babies are often named from some part of the body or from some physical trait, as snooty, bow-legs, thumbkin, bony-legs, fatty, neck, elbow, shorty, skinny, babeskin, brick-top, runt, curly-head, frowzletop, bushel, bundle, blue-eyes, bright-eyes, warty, reddy, shinny-bone, hair-pin, clothes-pin, tuning-fork, tow-head, lunky, chub, slab-sides, snow-ball, pinkie, nigger, golden-hair, pug, butter-ball, buster, broomstick, bean-pole, browney.

Even dress and other externals may suggest names, as boots, pants, buttons, smutty, shirtie, buttermilk, milksop, scarecrow, gig-lamps.

Character appears in such terms as old sober-sides, touch-me-not, cry-baby, crank, busy-body, blarney, high-flyer, dude, dirt, fraid-cat, girl-boy, pert, Miss Independence, Miss Giddy,

Miss Contrary, mutton-head, jade, chump, trot, yahoo, moper, harum-scarum, tricksy, sauce-box, wretch, villain, rascal, vixen, varmint, torment, tease, tender-heart, piety, tramp, trump, numb-skull, cross-patch, charmer, scaliwag, humbug, wild-fire, clod-hopper, romp, sunshine, smartie, sorry, sugar, cold-molasses, stick-in-the-mud, skin-flint, tom-boy, tell-tale, zany, Miss Sarcasm, lucky, slob, pest, Puritan, minx, nincumpoop, long-tongue, hussy, lunatic, pesky.

Closely related to the above come names suggesting characteristic acts, as wobbler, patticake, snoozer, chatterbox, trombone, tot, toddles, toddlekins, sticking-plaster, sucker, tumble-boy, bunter, rooter, bottle-boy, soap-sides, sot, snug, sozzle, sneak, lob, jabberer, music-box, hee-haw, cuddler, butter-fingers, squaker, squeaker, noisy (because so silent).

Names suggesting food and the sense of taste were common, as honey, sweetness, sweetie, sweet, sugar-plum, bun, sugar, dumpling, yum-yum, cake, sweet-meat, mint-drop, cream-cheese, chocolate-cream.

Repetitive and alliterative terms which appear in these returns are lovey-dovey, roly-poly, kit-cat, hun-pun, airy-fairy, unky-dunky, tootsy-wootsy, popsy-wopsy, flim-flam, hodge-podge, nizzle-nozzle, soft-snap, bed-boy, bottle-boy, piggy-wiggy, nipperty-tuck, buz-fuz, till-the-bell, the October-will, mumblety-peg, posey-woosy, lamie-wamie, orty-warty, highty-tighty, ducky-darling, bity-wity, enty-twenty, flibly-flab, etc.

Supernatural designations were angel, cupid, imp, devil, idol, phœnix, sphinx, spook, witch, cherub, puck.

Fictitious personages appear in, *e. g.*, Annie Rooney, Bill Nye, Dodo, Miss Muffet, Little Boy Blue, Humpty-Dumpty, Uncle Sam, John Bull, Dick Turpin, Two-Shoes, Topsy, Queen Bess, Hop-o'-My-Thumb, Punch and Judy, Ouida, Old Joe Jenks, Ornary Jim, McGinty, Josh Billings, Dixie, Rob Roy.

Often proper names not their own are applied to children as pet terms, *e. g.*, Becky, Teddie, Polly, McGurdy, Pete, Gretchen, Molly, Sally, Bob, Pat, Peggy, Nancy, Ned, Loretta, Lib, Lizzie, Mosey, Jack, Jake. Often a string of these are applied to a child, as Betsey-Jane-Maria-Ann-Betsy-Rubbage-Burney. Changing and exchanging names with their friends so as to act and be another person for a while must have a significance which, suggestive as it is, we cannot fully explain.

Terms used with more reference to their sound or noises than to their meaning seem to be lolly-pops, snooks, weezy, buggins, skeesucks, skeedunk, skite, coot, thimble-rigger, sniggle-fist, fliberty-gibbits, smuggie, chickapin, bodkin, slab-dab, fiddle-de-flumps, nobs, nibs, ninny-hammer, gicks, gibbits, pot-snap, dot.

Miscellaneous are aborigine, chum, cub, urchin, chap, thug, dew-drop, cud, star, diamond, diamond ring, curiosity shop, zip, young kit, squab, pearl, lugs, snow-drop, gipsy, Indian, mince-meat, Godie-on-wheels, Jim-cracks, cash-cord, ex-post facto, bow-wow, mamma's life, heart, sun, precious, jewel, bug-bear, cruddy, coddie, old-beeswax, tike, bitzen, swonk, buzey, gudgey, ducky-do, skidd-a-more, jusi, greaser, rag-baby.

Till the age of three one girl knew no other name than papa's devil. One girl was called dolly from resemblance to a certain doll till her true name was lost. At the age of nineteen one is still called baby by her grandfather. Mary called herself bay for baby, and it stuck to her as a young woman. Revilla was small and came to be called Minnie by all. One girl was called Jennie, till at the age of eight she ordered a change and would respond only to Ida, which became her name. Elizabeth used to call herself Liberty, and that is still her name at the age of nineteen. Till eight one had no name but sissy. A girl of thirteen knows no name but stick-in-the-mud, given her by her father. At the age of five Rose became cross if not called Ella, and Ella she became. A girl of twelve had no name but sweet, when she chose Anna Julia; and a boy sixteen, reared by a wealthy aunt, has no name but goody. Two twins had no name but baby till five, although often distinguished by the descriptive epithets warts and reddy. A girl ran away to Mr. Wetzelsterns, and was called Peggy W. up to the age of ten. Till the age of eleven one had no name but boy. Sometimes when they begin to write and go to school, or at the latest in the early teens, such children begin to feel the want of a real name. Children occasionally swap names, or one takes the other's name; one, *e. g.*, becoming Ida I and the other Ida II. Humorous names suggested for twins were Pete and Repeater, Max and Climax, Kate and Duplicate, etc.

Diminutives concentrate attention to a more intense focus, and every language has them. Adolescent girls torture their names, and often give themselves new ones, especially to add a characteristic *ie* to an appellation for the exclusive use of their most intimate friends, somewhat as Germans use *du* in place of *Sie*, or the French *tu* for *vous*, and secret names for the dearest friends are common. Boys, on the other hand, tend to ruder nicknames. A new boy who called all his schoolmates Thomas, James, William, instead of Tom, Jim, Billy, was voted a prig, and generally disliked. There is something wrong with the head or heart of parents who make a point of calling their children Elizabeth, Margaret, Sophia, Robertus, etc., from infancy, as do a small but *ultra* respec-

table minority of our correspondents, and as do a few of the most proper kindergartners. Ultra-saccharine and nauseating as some of the above epithets seem to the adult consciousness, their copiousness suggests the many-sidedness of childhood, when more than at any other period the manifold qualities of the race appear in the individual, and every new pet name is a new channel opened for new parental feelings. Love, whether during the honeymoon or in the golden dawn of true motherhood of soul as well as of body, still reveals to us a glimpse of the primeval impulse that gave birth to names, and that was perhaps one of the chief sources of language itself. Many of these designations reflect in the clearest mirror which speech can command traits of body, acts, disposition, etc., that help the child to new points of view of self before his ensemble of parts is labeled by a single conventionalized name that has lost all its appellative root meaning.

Guppy, Bardsley, Barber, Long, Dorsey and other investigators of proper names show that everywhere personal names preceded all others, that in England second names were almost unknown among the yeomanry before the Norman conquest, and that everywhere there was once a time when everyone knew the meaning of their own and others' names. Much primitive history can be reconstructed by a study of names, which sometimes spread from a single centre and enable the expert to solve problems where a study of race and language fails, so that it has even been said that boundaries like those of Alsace and Lorraine could best be determined thus. Names in open and accessible regions are oldest: "hill countries contain the ethnological sweepings of the plains"; the slow rise of woman is marked by a great dearth of female names, save those formed by feminine endings to the names of males. Places, family, great guild-industries like the cloth trade, moral, mental and physical traits, flowers and animals, landscape features, rank, office, mythology, war, priest-craft are found to be the etymological root-meanings of nearly all names. Among modern and western people local names abound, but are rare in the Orient, and almost never occur among plain-dwellers, like the Arabs. Most personal names were at first generic, expressing some property common to many individuals. The rise of industries, life amidst strongly diversified scenery, the development of religion, social and political organization, and wider knowledge generally unfolded or ever larger number and variety of names, till now with all these resources and a vast international repertory to draw from, together with the practice of assigning several names, almost every individual in a large community can have a unique and only name. The conventionalization and arbitrariness of

most proper names open the way again to euphony of sound, weird fancies, associations, and even to superstitions, which may in part explain the frequent sudden wonder that in the most unexpected way sometimes befalls children who feel themselves looking at, thinking or saying their own names and automatically and almost imperatively querying: "Why am I John or Henry? what does it mean? how strange and funny? how different would I be if I was Edward or Robert? what is John anyhow? have I, or could I have another more real or fit name? how should I live up to John?" Often some human quality is assigned to the sound or the look of the printed word. A student, *e. g.*, named McIntire, thought the head on his name too large for the body, that he should be making tires, was tired, should somehow be whole or entire, rejoiced that his narrow escape from being McGinty was a safe and sure one, thought the name was his by some accident and was meant for some other person, felt it insufferably tedious to bear forever, perhaps in eternity, the same tiresome name, that he must exchange it or somehow break away from association with so arbitrary and mysterious a symbol, or that it was a banner, and his life work was to plant it on some topmost pinnacle of fame and make it spoken with awe by an admiring world: all this in an intense, only half-conscious, revery-like way.

VI. Most children conceive the soul or self in some particular form. (a) In Mr. Street's returns, above referred to, 144 thought it shaped like the body, as it is in many additional and supplementary returns to my own questionnaire. It is thin, ghost-like, perhaps bluish, or light gray; may be made of mist, fog, smoke, cloud, breath, gas, vapor; is often transparent; draped, but rarely colored; light enough to float; subtle enough to pass through walls, and sometimes with an aura of dread or physical chill. It is akin to shadow or the dim reflection in water which primitive man often identified with the soul; and it may be a baby, a giant, or small as the image in the eye.

(b) Many children conceive the soul as like some part of the body. For most of these it is heart-shaped, a heart in the heart; perhaps smaller, invisible, or else a special part of the heart, or a second heart above, beside, or set in the wall of the fleshy heart. For others, the soul is just red blood; for others, the stomach or abdomen shaped like a round bowl. A few make it the liver, a tongue perhaps of fire, a particular bone, lungs, brain, sexual organ, navel, the skin with nothing or air in it, phlegm and liable to be coughed up and partly or wholly lost; and some conceive it as a head with wings, an eye, a beautiful, perhaps trans-

parent, or jewel-like hand, or a pointing finger, or more often a foot of wondrous form and tint, or its sole (suggested by soul), or something set in or inside of a foot. For some it is the skeleton that goes to heaven or hell.

(c) Next in frequency come animal forms. The soul is conceived as a dove, butterfly, eagle, turtle, mouse, worm, caterpillar, snake, spider, cat, hawk, bird of paradise, maggot, lion, wolf, as any chance analogy of sound or figure of speech may suggest. These forms are often associated with the quite prevalent idea of children that they may become or have been animals, and less often with their propensity to imitate their acts or noises. On this head, as in so many others, the data are too meagre, but are full of interest, and suggest a tempting line for further research.

(d) The miscellaneous soul forms have a very wide range. Little girls often conceive the soul as a flower in full bloom dispensing fragrance—an image that may persist and undergo a high degree of refinement. It may be suggested by the child's name or some song or story. A stone either white or brightly colored, or a jewel of various size, shape and situation may do duty for soul. So may a glowing coal, a flickering, pale flame, or darting tongues of fire. Souls are stars, comets, winds, noises, clouds, not unlike those shown on a screen by Mrs. Besant, which are pink if in love, green if jealous, etc. They are fine lace, or soft, like velvet; good ones are white and bad ones black, with all intermediate shades of gray. Bubbles are souls, eructations, odors, particularly incense, suggesting Jäger's soul-smell; sparks from the fingers are parts of the soul, and lightning is new souls coming down from heaven. We hear souls in echoes, words, voice, and speech is soul, and so is animal heat. Souls may be egg-shaped, and in the exact middle of the body, made of liver and too large to get out of the mouth till it is greatly shrunken by illness or broken by calamity or accident. They are tissues, perhaps wrapped around the heart, on which acts, especially our bad ones, are written and can be read, or they are invisible and live in heaven, coming down to the body only at death. There may be several and, occasionally, many souls. Hartley Coleridge used to describe his picture soul-echo soul and shadow soul. Not only in dreams, but in waking souls may wander far away and visit absent scenes, and may get lost, strayed or even stolen by some hocus-pocus. Our souls may hold close communion with not only God and the dead, but with the souls of animals and plants, but no case appears in our returns of this communion with thing-souls, although this is commonly thought to occur. At the age of ten Louisa Alcott imagined her mind as a round room

and the soul a winged animal in it. There were shelves for the thoughts, and the "goods" were kept in sight, while the "naughties" were locked up, but kept getting out. Some bright children, even as old as fifteen, not only have no idea of soul, but never thought of any such thing, and to do so seemed uncanny.

Many, if not most, of these views are products of suggestion of some sort from pictures, literal interpretations of figurative speech, accidents of experience that cannot be traced, etc.; but their form is also conditioned by the necessity for the child to think in concrete terms of sense. To conceive abstractly even heat, air, wind, echo, smell is hard. Psychologists have often urged that we must drop all physical forms of thought in conceiving the soul, and held that to give it shape, color, weight or place is idolatry or materialism, that not only every metaphor of sense which gave rise to the very names, psyche, soul, spirit, animus, must be diligently eliminated, but that the root principle of the self or ego has no relation to time or space. Such extreme purgation muddles thought and may make our science and its application to education mere verbal cram, destroy every real criterion for eliminating contradiction, and favors crass reactions like modern spiritism. It seems thus a problem of great pedagogical importance, quite apart from materialism versus idealism, what images and metaphors should be used as most consistent with each other, most flexible to express facts, and what, if any, of these survivals of childhood should be preserved, at least for a time, and which should be eliminated. Until we can have some, at least, general conception of what we are dealing with in soul science or in education, we are exposed to the most wasteful and contradictory theories and practices. Are we studying or teaching a ghost or a brain, a shadow or physiological structure, a blue heart, a flame or echo, a state, phrenological bumps, or all together? Can we have a hypothetical soul-stuff that can be thought into modern brain histology and physiology, without being exposed to the obvious objections to materialism? The crass idea of matter is giving way at every point to a dynanism far more subtle than any conceptions of spirit were or could possibly be up to recent decades, and the intricacies of neural cells and fibres, their chemical complexity and rapid metabolism should be expressed in some neo-monistic hypothesis of the soul that education needs to take the place of such rags and tatters of superstition as those described above, and which often persist into adult years as a heritage of childhood.

These infantile conceptions are not a permanent back-

ground, a totality of experience, a unity of any manifolds, not more real, but often less so than the most vulgar things of touch, are neither products of psychological interpretation nor of metaphysical thinking, so that it is natural for the well-equipped psychologist to feel that his first duty is a muck-running iconoclasm that seeks to make a waste *tabula vasa* of the beginner's mind. This, I believe, is wrong. He should, with young students, reverse certain current methods, and instead of discussing the ego last, as most psychologists now do, the wise teacher will begin here and exploit the views of savages, children, animism, the soul-theories and discussions of Plato and Aristotle; touch not without a trace of sympathy Jäger's smell theory; explain the doctrine of sensible species; soul nomenclature; describe the mythology of souls of fire, lightning, animals; utilize wisely modern and ancient spiritualism, views of theosophists, reincarnation and transmigration, burial customs, ideas of absorption, diffusion, traducian and other views of the origin of souls, the different ethnic conceptions of its post-mortem existence, and from these topics pass to pleasure, pain, fear, anger and other feelings with instinct in animals, then to intellect, and sense last. Thus the grosser residual concepts of childhood would be eliminated, anthropomorphism felt in all its universal and constraining power, and an attitude of mind more tolerant and sympathetic than critical would be favored. It has been a grave misfortune that psychology has so often started with a study of sensation which, whether theoretically or experimentally treated, has as its *pons asinorum* on the very threshold all the bewildering scruples concerning reality and the nature of knowledge. The place for this is nearer the end than the beginning of philosophy.

The soul has been "entified" in many ways. It has been regarded as a split-off part of the *primum mobile*, an emanation from God and con-substantial with Him, pre-existent in, or as a star, coming voluntarily, or being sent to earth to take on the clog of a body as a penance, transmigrating through many lives, created at a given moment and put into the embryo, or physically propagated in familiar traducian wise. Ancient materialism conceived it as the finest, lightest and most subtile and pervasive matter. In ontological periods it is deemed a substance in which its qualities inhere, a nouminal *thing in itself*—clad in its faculties or ideas as phenomena. In ages of fear or impending judgment, stress is laid upon its simplicity and incorruptibility, so that fire can not decompose it, and it could survive even the awful cosmic weather of some *dies iræ*. In the early days of the calculus, it was conceived as punctual or unextended, and now it is often de-

scribed as absolutely spaceless and timeless.[1] As combining these latter transcendental features, there never was anything so impossible in fact or hopeless to know. The monsters that children sometimes fancy that never could live are compounded of less incommensurate and contradictory attributes. Such a soul is not a mere jabbermock, but perhaps the most hopelessly hollow *flatus vocis* ever spoken, to lose which would not require Plato's windy day, and would be a wondrous gain to psychology.

Mental imagery for psychic processes has been greatly helped by neural concepts, although these are at present often confusing and inconsistent. Most common, perhaps, is just now the fashion of speaking of chemical molecules that are built up to a degree of complexity and by action reduced to a simpler state. But we have combined with this the thought form of the instability of a pyramid balanced or toppling on its apex, and also of loading and unloading, or discharging. These chemical concepts connect with Luys' phosphorescence, combustion, with the trophic background of life and mind, with products of decomposition, etc., and need careful and new elaboration. The days of Galvani and Volta, when even Humboldt printed two now obsolete volumes on the marvelous reanimation of tissue by electricity, have given us many thought forms, polarities, positive and negative, indifference point, long and short circuits, tension, conductivity, currents, etc., and are also helpful, but of a different order. Thirdly, the old idea of vibration still does service. In the days of Weber's long experiments with waves in his mercury

[1] As one example, from many that could be cited, see President McCosh ("Psychology of the Cognitive Powers," p. 8 *et seq.*): "We are not to allow ourselves to look on mind itself, or any of its operations, as occupying space, as extended, or a figure as having weight, motion, or rest," etc.

This reminds me of a scheme, of an opposite but perhaps no more absurd character, which I tried years ago in a lecture but long since abandoned, as follows: A *psychomorph* is the space area within the body in which any kind of physical action or change occurs that is involved in a psychic activity. This generic term covers all changes in muscles, glands, nerve cells, fibres, blood vessels, etc., but does not include external concomitants, as radiant heat, electric changes, and still less any alleged telepathic effects. A psychomorph, in other words, is the figure in space that would be stained by some reagent, if such can be imagined, that should paint the locus of all these changes as litmus paper reacts to acid and alkali, or, if all psychoses left their trace through the soma, like retinal purple. Of course localization has not progressed so far as to define very accurately this space for any single act or class of activities, although some pathological deliminations approach it, and it was only intended to emphasize a protest against the maddening surd of hyper-spatial and non-positional soul concepts. A *neuromorph* is the neural part of the more holophrastic psychomorph.

trough at Leipzig, a sine oscillation was almost thought to be the key of the universe, and Hartley's idea, sometimes strangely commingled with a perhaps Platonic concept of the soul as a harp, the brain as full of humming and tremors and making Æolian harmonies linger with us, not only in the fact of the sympathetic action of Corti's organs, but in the quackery of vibration cures, and allies itself naturally with the tonicity of intermittent muscular discharges. Again, we have the concept of a tissue, plexus, web, woven of complex texture: here, compact and firm; there, open and gauzy; or, if this is too intricate, or when fatigue overtakes us, we say the elements are felted or macerated; and yet again we have a hydraulic system of tubes or channels, deep worn, rutty and with narrow, rapid, or slow and uncertain, or with the currents obstructed. The old idea of images, eidola, copies, patterns, etc., still occasionally helps us out. While the Herbartian mechanics of thoughts rising above a threshold, colliding with or adding momentum to each other, is widely used with analogies from light and heat, reflection, struggle for survival, pressure, stratification and layers, volatilization and inspissation, mirrors, etc., but every article in this well-stocked property room of the psychologist is emasculated and with a kind of limbo reality suspended between merely diagrammatic illustration and the solid ground of histology and physiology, requires an incessant change of mental register, and, if we take it too seriously, it tends to the madhouse. How most of these concept forms can be utilized and confusion obviated, I shall try to show later.

Psychology needs a soul not so much as a *rendezvous* of

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An *ideomorph* is the space area containing the somatic activities involved in thinking an idea, and a neuro-ideomorph that of the nerve action involved; its miomorph is the muscle area concerned. Boulomorph, geusomorph, haptomorph, chronomorph and osphresiomorph explain themselves. As each sense was thus provided for, I could use æsthesiomorph for emotional areas; hormemorph served for instinct; nosomorph for disease, etc. The prefixes established in morbid psychology—meta-, para-, hyper- and hypo with a, ana and kata—also were occasionally convenient.

Secondly, the word *dyne* with prefixes, psycho and neuro, was used to denote the intensity of change within the morphs. If the changes were cytomorphic, the energy involved was cycodynic. *Troph*, with the prefixes, designated the supply of nutrient material, not its use. A *trophomorph*, *e. g.*, is the area of increased vascular supply. Finally, a *toxomorph* is the area of deleterious, or of waste matter, due, *e. g.*, to fatigue. All psychomorphs may be thought of or defined by surfaces of isodynic intensity, some one of which marks the threshold of consciousness, below which only neuromorphs of decreasing degrees of dynism exist. Practice reduces the dimensions of boulomorphs, while increasing their dynism; hesitation does the reverse, etc.

concepts, or a basis of categories, or to make an identity of background, without which thoughts could not be connected; or as an eavesdropping "I think," which Kant said accompanies all processes, but which others believe to be only the creaking of defective mental machinery. It is not satisfied with inner perception, a *sensus communis*, with Czolbe's "sensation of relation," with Lotze's subjective ego, as "the theoretical explanation of somatic self feeling"; nor the Herbartian struggle of psychic elements for self-preservation; nor with any of Bradley's six kinds of self-consciousness; nor with the precipitate nostrification of current conceptions of the social self; nor with the idea of a confederacy of personalities into which the psychic dissection of hypnotism sometimes resolves the human psyche; nor with the gallery of memory pictures illustrating a biography which Hobbs thought made personal identity, and the loss of which Schopenhauer thought was the cause of insanity.

There is now much agreement that all these difficulties admit of practical solution by simply assuming the reality of an ego, more or less autonomous as a regulative hypothesis and going to work, holding perhaps with Froschammer that the mind grows inward, deep, free and unitary just in proportion to the volume of the world process that passes through us to deeds and history. The sensory regions of the brain seem better connected with the motor area than with each other, and find in it the unity they lack in an inactive life. If modern personalities are in growing danger of disaggregation as life becomes sessile and passive, and if the self be as Hirth thinks, merely a biologically useful illusion which really helps us to cement the mosaic of our ego synthesis more firmly, it is at least a platonically "noble lie," and should help us against velities and caprice, absence of life purpose, and kindred practical dangers, beside which the grossest heresies about the ontological nature of selfhood are as insignificant as what might be called the allotropic debates whether the Iliad were really written by Homer, or by another person of the same name.

Indeed, do not the above classifications of children's ideas of the soul, to say nothing of the philosophical propensity to substantialize it in a way that, as the psychic researchers copiously illustrate, tends to apparition theories, show that, just as certain forms of nature worship in children prepare the way for purer religion later, so a dignified and modified epicurean materialism may at a certain early stage of thought be the best basis for soul, immortality, and even God, bad and false as this is as a finality? For the pedagogy of the ego, therefore, this should follow the above discussion of the

crude soul ideas of children and savages. At least this is better than a soulless or epi-phenomenal psychology.

VII. Certain philosophic stirrings often begin very early in life in a more or less automatic revery of questioning the validity of (a) sense impressions. Many describe in their own early lives or in children they know sudden outbreaks of questioning, whether window, tree, hand, etc., that are being gazed at, are real. "Do you truly see this?" "Is it real, or am I dreaming?" Some objects suddenly seem strange, queer, funny, and children pinch themselves to be sure that they are awake. This experience is most common with vision and rarest with touch and taste, but not uncommon with hearing. "How do I know that objects are not mere appearances?" These experiences seem to originate in some phenomena of sensation, perhaps in some transient functional unhitching from motor or reactionary centres, and this stimulates the questioning, which may extend to the whole of the visible universe. Perhaps the sun, moon, stars, sky, clouds, distant hills are doubted and seem to need some vouchers for their reality. Children look very hard at objects sometimes in an almost dazed way, perhaps open and shut ears, eyes, or both, as if to test the permanence of sensations. When glasses are first worn this primitive scepticism sometimes first makes its appearance, or when things are seen through colored or obscured media. These experiences often occur in spells of revery or idle contemplation. Juvenile reflection easily extends to spectral doubts about the world or things generally. The soul seems to be herding ghosts or phantoms instead of the wonted realities. These impressions can hardly be explained as hypnogogic, for sometimes the mind is roused at once to the greatest interest and activity by them. It is as if there were a sudden divorce between sense and thought and the visual apparatus became unusually objectified and its deliverances held off at a distance for scrutiny. While the senses act normally they are more reflex and automatic than usual. Perhaps thought or feeling now first declares its independence of sense and now actualizes a deeper reality, more intimate and internal, compared with which objects seem shadowy by contrast. If so, these experiences mark the growth apace of a more spontaneous and vital self, until the world seems a mirage or hallucination for an instant, and perhaps the Berkeleyan argument has this psychologic genesis or point of departure. These dim flitting experiences could not occur without causing, or unless caused by a deeper sense of self.

(b) We must make another although related category for such queries, no less common, as: "Am I real?" "Do I

really live, or am I only make believe, like dolls?" "What am I?" "What is it to be an I?" "What do I do when I think, or what is it in me that feels, talks, etc.?" "What makes my soul and body so different?" "You strike my hands and feet and hurt them, but cannot hurt the real me inside." "Why can I not see myself think when I close my eyes?" "How will my soul look when I am dead?" "What is the me that you cannot see if I close my eyes, or if I hide my head so you can only see my body; or, what is it makes my legs walk?" "What learns my lessons?" "What lasts all night, so I am not changed in the morning?" "Why am I the same that I was as a baby?" "What is it that is sorry, glad, happy in me?" "Why does it hurt me when I cut my finger?" Several describe themselves as pondering over some of these problems by spells, asking their parents without satisfaction, and even becoming tired, frightened and half sick by being preyed upon by such insistent queries. Perhaps this marks the dawn of self-consciousness proper when the ego is first glimpsed or felt after. No returns in our repertory show a trace of Hume's scepticism, but the ego is assumed to be both substantial and actual. Perhaps now new sources of inner energy and spontaneity are opened, and in its new-found independence of self, the soul finds one of Fichte's new potencies. To be able to think, feel and will in emancipation from the thralldom of sense and its reflections, marks the advent of a real psychic freedom that first manifests itself in these crude hieroglyphs of experience. At any rate I am convinced that it is possible to approach the whole problem of epistemology from a new genetic standpoint, and that these experiences suggest it.

(c) Quite distinct from either of the above are the frequent juvenile questionings that suggest the possibility of a very different consciousness or self from that at present existing. "Am I myself, or not?" "What makes me the way I am?" "Why am I not she, or why is he not me?" "If there was no I, would there be another in my place?" Fifty-four returns describe wondering how it would have been if their father, mother, or both, had been different. "If papa had married B, whose girl would I have been?" "Would I have had curls?" "How different would I feel, act, look, or would I be at all?" Children very often suffer for years, perhaps in silence, with the fear that they are adopted and their parents not really theirs, and interpret all that happens about them on this theory, against which no assurances avail. Often they play, sometimes for weeks or months, that they are others, or have other parents. "What name would I have had if C had been my mother?" "Would I have been

in heaven?" "gone there without coming to earth?" or "just not been at all?" Children often go over the list of their friends to see if they would become or change places with them for a time or for good. "Why was I not M (another girl born the same day)?" Some long to get into others' souls to see how it looks there, to get secrets, or to be different. Some imagine themselves someone else, to see if others feel toward us as we do toward them, to escape ennui, or to know how it seems to be colored, etc. They wonder how it would feel to be a tree or rose. Many wish to be flowers, and a bright girl of four believed she was a speaking flower. Imitations and even impersonations of animals are still more frequent. A girl of five, *e. g.*, imitated a horse persistently for days, others will drink like a hen, cat or cow, or insist on sitting on eggs and roosting with the hens, pretending to fly, until they almost fancy they do.

The dramatic passion is almost universal with children. They personate all kinds of people, and imitate even defects. "Let us play we are sisters," said two sisters, as if the fiction gave added charm or perhaps reality to the relation. It seems as if children sometimes hate to have or be a self; felt that personality was not essence but phenomena, and before they attain the virtue of unfolding what is peculiar to self, strove to develop what is common to all the species; feel reluctance to be merely a specimen of a type, and experience a touch of the sublime indifference of nature and of philosophy. A girl of five wrestled sometime with the problem, "Am I not a dog straightened out?" In their plays children even become a post, street-lamp, rock, chair, mirror, table, tree, etc. Only five children state that they long have deliberately wished to become another. A girl of six passionately felt that she could and would not be herself; because it was too dreadful. When angry or forbidden some desire, children often wish they were someone else. Girls frequently wish to be boys, and often expect to be when they are older, or fear they may become boys. Others fear at night that they will wake up someone else in the morning; others suffer greatly for fear that they lack sense, or are idiots, or insane. While special features, qualities, accomplishments, brain, stomach, knowledge, music, gifts, disposition, and still oftener wealth and circumstances of others, are very commonly desired, a great majority are glad they are themselves and would not really be turned into anybody else, especially into certain persons whom they dislike. "I am glad it was papa who found me before anyone else, for they might have changed me." "You wanted a boy, but did not know it was going to be me," said a boy of four. "What was I before I

came into the world?" "Were things the same before I was born, and will they be the same, or will they be at all after I am gone?" "What if I had not been born?" "Where did I come from?" "Why are we in the world, anyhow?" "Will things stay when I am old?" "Who is God, anyhow, and why did He make souls and give us thoughts and watch us use them?"

These phenomena are hard to interpret, but suggest that childhood is generic and full of promise and potency of many kinds of personality and consciousness before the shades of the prison-house close in upon it. There is a trace of pathos if not injustice about separate existence. Individual experience is so partial, so limited—heredity with its vague masses of ancestral reminiscence is vaster than any individual life or mind can express,—and the frequent sense of being exceptional or strange suggests that what we call consciousness is dross or a frothy syllabub, and that there is a larger subliminal existence, a *natura non naturata* of the soul that is doomed to remain a dim region because the light that might illuminate the whole obscurely had to be concentrated in some part, and because personality so involves limitation. The hunger for life may become almost a passion to know what is taking place within other skulls than our own. We desire to be citizens of all times, and of all grades of being and spectators of other souls from the inner standpoint of their own consciousness. The confessional, intimate social converse, knowing and utilizing others' experiences by the questionnaire method, etc., owe part of their charm to the longing for the broadest possible basis of experience and to touch life at every possible point, even if it be vicariously.

(d) Another experience of childhood involves a certain bifurcation of the soul. When they cry many children pity themselves, run to the glass to see how they look, and, even in much agony of grief, waste a great deal of sympathy upon themselves, feel sorry for themselves if they are angry or in pain, sympathize even with their moods, and try to comfort themselves if vexed or gloomy, seeming to stand aloof like another person and feeling sorry for themselves that they suffer. Many stroke and pat themselves, address themselves by pet names as if they were someone else, feeling that pity is their due. Others, particularly girls, when tired or ill, love to fancy themselves growing weak, fading away like a flower, dying young in a flood of self-pathos, bitterly bemoaned by imaginary friends, and are comforted when weeping by observing how red their eyes are and how miserable they look. Others try to help themselves by giving counsel or offering reasons, apostrophizing themselves as

hateful or shameful things; others conceive themselves as made up of good and bad selves, which dispute, argue, and strive for the mastery. Scenes are fancied and even trials at which oneself is judge, before whom the good and bad selves argue the case. "I went where I was forbidden and enjoyed it, but felt it wrong, so there must be two of me." Dialogues and soliloquies, often exciting and in some cases becoming habitual, occur. Especially in the country, children sometimes discuss with themselves nature and their own moods; talk with winds and trees, and imagine answers, mutter dialogues between their own desires and the absent but imagined parents or conscience; and sometimes inflict blows upon themselves if the controversy becomes heated. A few children address their bad desires as Satan; shake themselves, after disobeying, to get him out, etc. Even infants often cry intensely, but peep up to see whether they are carrying their point; cry for effect, and perhaps stop and play happily with ludicrous suddenness if they find themselves alone in the room. Such phenomena as the above are no doubt mainly due to and are among the earlier forms of a social self-consciousness. The real child is the one party, and the will or command of the parent, or the standpoint of the spectator interested or disinterested, is the other. Some of these experiences suggest an almost primitive outcrop of some sort of categorical imperative, if Kant's term is really the proper characterization for conscience in its nascent state; while others suggest one or more imaginary companions. The latter are often only extreme cases of this bifurcation.

(e) Stronger, perhaps, than any of the above tendencies; stronger than the sometimes half insane rage for questioning about God; the remote and infinite in time and space, that make children seem to leave the world and fear that they shall wake up and find there is no earth or anything else; stronger than the backward gropings of the soul toward its own beginning and cause, is the universal protension toward maturity which impels every child in its plays and thoughts to anticipate adult life. Children imagine and imitate "grown-ups" in dress, manner, conversation, select their vocations when infants for the pettiest reasons, until it seems as if the view of Groos was right that most of their games are practice for what must be their adult activities, and that this is the chief business and purpose of childhood. They long to be rag-men, to have nice bells; express-men or conductors, to ride all day; merchants, to have candy; teachers, to mark on the board; milliners, to have pretty hats; plumbers; milkmen; boarding-house keepers, to get rich; a drummer, errand-boy, etc., because some friend is. But on the

other hand the limitations of Groos' theory are painfully apparent in a large class of play activities I shall describe elsewhere, which seem to exercise rudimental psychic organs and to give them the needed stimulus to vanish before maturity can be attained.

When any sense impression is regarded as such, which occurs most often first in revivals in the absence of the object, the first invagination of an inner self occurs. But for the power of revival shown in spontaneous recollections, self-consciousness in the epistemological sense would either not arise or be long deferred. This occurs in the various sense spheres, in each of which residua of past sensations accumulate in stock, and are arranged like to like by agencies related to those which which Maxwell called "sorting demons." We are already on the way from Locke's first to the second of his two sources of all knowledge, from sensation to reflection. This involutive process works at each sense-centre, and will slowly carve the inner self out from the body as the childish experience above described deliminated the skin-bounded body from the world of impression in which it was first imbedded. About every efferent centre motor images are also accumulated. At first inner perception is a dim realm of shades, but the shades gradually take on reality, form, color, motion, and may be mistaken for sensations themselves. This introverted, gastrula-like stage of thought is often marked by what seems to stupid and morally bigoted parents and teachers, lies. "I saw a thousand bears and tigers in our yard," means a sense image of a number of these animals springing up in my mind clearly and for the first time without any corresponding objects, while it begins to dawn upon the child that he carries possible menageries in his imagination and is getting independent of sense. Perhaps, too, in the embarrassment of being overheard talking to himself, he learns the difference between speaking and thinking, and divests his psychic processes of other muscular forms of expression, and learns to think acts it cannot do, for repression excites subjectivity. These lies of sense and of achievement are a quite distinct stage of mental evolution to which we shall recur, because the power to play and work with these seems to mark the line between the animal and the human psyche. The outer is known through the inner, there is a perception of the products of former perceptions. The child no longer gives himself fully and with entire abandonment to the objective world, but begins to draw back a little even from his own body, which ceases to be a part, or at least the whole, of himself.

As thus self-consciousness slowly arises by involution from

object-consciousness, and apperception from perceptions, instead of lingering in the lower regions of sense images the noetic passion may strive for a knowledge of knowledge raised to some higher potence, and be drawn towards the vortex of the mysterious but fatal involucre of solipsism, which, to change the figure, is like an encystment, from which the soul has no palingenesis. No matter how many rival ways of escape from agnosticism may be patented, just in proportion as the world comes to seem only my concept will every volitional or emotional reaction upon it seem unreal. In speculative, as in morbid psychology, delusions of greatness go with progressive paralysis. Fichte's familiar but unique and matchless romanticizing with the idea of self by anthropomorphizing the universe into an absolute cosmic ego, whose essence it is to posit itself as being, whose "I am" is the only possible deed or act, to which all objectivity is only its own reduced activity, and which is to be annihilated and destroyed by moral reaffirmation, may slightly inebriate the sanest of us, but we must not yield to the fatal *ubris* of Titanism, and try to inflate our puny egos to God-likeness of this kind. Presentation, representation, re-representation, etc., however far continued, and on however many superposed Jacksonian levels which the future may make possible, and to whatever high potential knowledge may thereby be raised, can have no other possible meaning than a practical one. We are not forcing the ego back to its lair, stripping off its more outer and then more inner garments with any possibility that it will ever thus, as Tertullian prayed, stand forth at last, naked, pure, free, a precious kernel, fully shelled out of its last husk. To assume any identity between subject and object, as Schelling did, or even an Hegelian equipolence, is to belie the very nature of the fiery particle within us, which, as if it were the culmination of the biologos itself, is not expressed in any of even all of the forms it has made; but whose essence it is to create, and which is the only *actus purus*. By its spontaneity the attention presses in from point to point, and what it has been and done is only the prelude to what is to come. Whether it will ever entirely eject or objectify itself in some far-off apokatastasis, whatever such a state may have meant to the mystics who have reveled in its description, seems extremely improbable, because, in nature's economy consciousness is always either remedial or directive, and the automatic is always closing in upon it. The idea of a centre or a state of all consciousness, as we understand that most polymorphic of all terms, whether of a being who simultaneously knows all, and directs all details of the universe as steps in accomplishing a maturely deliberated policy, or of

monadic souls, each *parvus in suo genere deus*, reflecting the entire universe, is a dream of lotus eaters, a fool's paradise, for it immolates nature, whether human or divine, to intellect. In fine, introspection can never solve the problem of the self.

VIII. The influence of other selves upon our own self begins in the mysteries of heredity and takes a more objective form in gestation. Whether the mother's movements are tranquil or sudden and violent is registered upon the body and soul of the new life she carries, as the planchette records every change in the tension of arm muscles; she who does most for herself does best by her unborn child. When after birth her movements act no longer through a fluid medium, her touches, pats, caresses, the act of nursing, etc., make for some time a large part of the child's outer world of change. Perhaps as probable a beginning as any for the social consciousness of the child is its first recognition of its mother's face, which occurs during the first few weeks of life, and which many of our returns emphasize as an event of great distinctness and importance, as did Froebel. The child is born with the power to cry with great vigor, but the power to laugh comes very gradually and later, and it is often this recognition that causes the first smile, and may excite it to writhe all over with joy. It is easy either to speculate or poetize about this event. Before, perhaps, the child is solitary, alone in the universe, so far as its own rudimentary consciousness is concerned; but now the first "thou" looms vaguely up in the void. Possibly, too, this moment is the natal hour of the world of objects, of all of which its mother's face is the "promise and potency," and from this as a starting *point de repère* the child's mind slowly delineates impressions of other selves, if not things, etc. At any rate, it is the eye that chiefly fascinates, and, although a stranger might have been detected before, especially by touch, this eye and face at least are now known to sight. Sympathy is now born, love has its object, the recognition involved marks the first conscious memory as an act of joy of a new and unique kind. Starting from the face and breast the mother's body is slowly defined, although her eyes and, perhaps, mouth, hair, etc., are noted first; the child notices its own hands, feet and ears before it does those of its mother's, and also becomes aware of its own internal organs and processes first, and the instinctive comparison part by part above described defines its first somatic "other" as well as its first somatic self.

Meanwhile the child is subject to many manipulations by the mother. Her face is associated with a vast variety of touches, sounds and movements that make her the source of a great part of all the changes possible in the infant's psychic

horizon. She causes it to pass from hunger to satiety; from cold and wet to warm and dry; from one attitude and position to another; her presence means every possible pleasure, and her absence every possible pain. The sense of being alone even for an instant is the desolation and horror of the abyss. She is the child's Providence, on which it is absolutely dependent to a degree that few of the most religious men ever really conceive themselves to be on God. If she fails to make herself thus the bright focus in the child's nascent social consciousness and be all a good mother can and should be, the child's own personality will be less organized and unified and will have less power to reverence the divine personality at the heart of the universe whose place she is shaping in the soul by her own, almost as the wooden model makes the matrix in which the iron will later be cast. She, for a time, embodies its entire world of others, divine or human. She is society, and from her all other persons are learned and differentiated. They, too, dawn upon the infant's mind as she did, eyes and face first, suggesting platonic or cherubic heads, and are slowly defined in body and act as she was.

Again, in all its good moods the child's rapport with its mother dominates its conduct. It early comes to do all she smiles at and to avoid all else, as if its only vocation were to divine and follow all the lines of her likes and wishes. Its nature expands not only toward, but in proportion to the sunshine of her favor. It respects all she smiles at, even buffoonery; looks up in its play to call notice and study the currents of her sympathy. If she is happy when the child is good and slightly saddened at wrong, the normal child will choose the right as surely as pleasure increases vitality. It cannot act on her fear and should not on her resentment, but it can act on her love, and if that is strong and deep, obedience, before language can be much understood, will be an instinct. The mother, too, is the child's first pattern and exemplar, and sets the copies for a mass of imitation, conscious and unconscious. Her rhythms in motion, accent and inflexion are a contagion. As she is quiet, poised, reposeful or excitable, spasmodic, irritable and nervous, so is the child. If she is happy, euphorious, contented or sour, full of symptoms and aches, discontent or anxiety, each of these moods is reflected in the child. All these and a host of other influences emanating from the mother are registered in the basal strata of habits in the nutritive and motor systems, in rhythms of rest and fatigue, etc., that are not only unchangeable themselves, but condition all later superstructures.

But as a new planet is gradually thrown off a central sun

and slowly spheres itself and finds an orbit and then develops forms of life all its own, so the infant soul develops slowly to independence; but as the planet was made from the matter of the sun and never escapes gravity, so the soul never can escape what the mother was and did to it. The infantile charm of bo-peep plays with impressions of momentary existence without her. The timidity, fatigue or health of infants at a certain stage we may conceive to vary inversely as the square of the distance at which they can be left, carried, creep or walk from the mother before the inevitable sense of solitude or fear of getting lost overwhelms them. Other members of the household become too slowly increasingly prominent factors in the development of the child's social consciousness. For country children the interval between the family and others is more marked than in the city; for the former in their earliest years and also the family have more definiteness and also stronger attractions.

Soon two tendencies develop: one centripetal, inclining the child to its own home of which the mother is the heart, and the other centrifugal. Homesickness and the passion for other scenes and faces, illustrated, *e. g.*, in truancy and the migrating instinct, often struggle with each other. Some children wander away, launching out into the big world, and leaving all behind them without fear or regret, while others show an equally abnormal dread of getting away from familiar faces. Owing perhaps to some reverberations of the ancient war of all against all in the long and bitter struggle for existence, all strangers, especially those with too unusual dress, features, acts, etc., are at some stage more or less feared, although with great difference of duration and intensity in different children. A peripheral limit of the expansive social tendency which radiates from the mother outward is marked for most children by deformed or colored people, policemen, soldiers, tramps, the doctor, coal-man, rag-man, etc., whom they fear. Between the too familiar and the all too strange and dreadful lies the wide field where the expansive social tendencies as love, slowly widening to include mankind, nature as a vast repository of personification, and curiosity which would see, feel and know all, meet and mingle with the deeper counter-currents of ancestral dread, and make strange eddies and whirlpools in the brain cell, nerves and pulses as well as in the soul. In some children the latter predominate and they are so embarrassed, shy and timid that they can do nothing before strangers without awkwardness and mental confusion. The attention of friends to the acts or persons of such children is the kinetic equivalent of the presence of strangers in its power to overstimulate inhibitions or to

excite bashfulness; to be looked at is as paralyzing as to be placed before an audience. "Don't let anyone look at me," is a frequent request when something is to be done and a steady gaze may not be the "evil eye," or have power when directed to the back of the head to cause one to turn around according to current superstition, but arouses painful self-consciousness or anger in children, and is often construed as an insult by adults. Others love to be in the focus of attention and do anything to attract and hold it; are stimulated by it to all sorts of "showing off," and are spoiled by flattery, and dull without it. The passion to be interesting and to compel others to like them may make children bold, vain, affected like George Eliot, who at the age of four would pound the piano with many airs if anyone called, or to make the servants think she was a great musician, yet this indicates great social sense and capacity. Such children are likely to lose the proper balance between love and fear which gives the psychic tension called from its various degrees and forms bashfulness, modesty, respect, reverence, docility, etc., all of which are manifestations of fear toned down, and variously tempered and allòyed. The very acme of social zest is where some expansive impulse has just won some new victory over fear, and the stranger, the bully, teacher, etc., treated with some new familiarity, the person with decided or superior manners, the critic or enemy faced. There may be flushes, tremors, or even conflicts, but the self grows with every such courageous affirmation.[1]

[1] Professor J. M. Baldwin ("Mental Development, Social and Ethical Interpretations," p. 195 *et seq.*) thinks there are three stages of bashfulness: first, a primary, organic kind in the first year toward strangers; second, an opposite tendency to tolerate strangers and like persons generally, due to kind treatment; and third, a return of bashfulness in the second and third years. The second stage is said to have its phylogenetic parallel "in the rest man took after his release from the animal." This second stage of loss of fear, the author sees illustrated in the life of the Hebrew patriarchs, etc., and discusses whether such a period occurred "over the whole earth at once," calls it in a note a "well recognized period," but says that to confirm it would require much research he cannot bring, and hopes that his declaration of the hypothetical character of the parallel will appease the "learned critic whose red-rag instinct is keen for theory."

I can not find, nor can several anthropologists I have consulted, any trace of any such "well recognized period," nor anyone who ever thought that it existed "over the whole earth at once." Indeed there are many reasons why such a stage must have been both geographically and ethnographically limited in extent and brief in duration. Again, it is not the infant of one or even two years that would reflect the race stage described, did such stage or its reflection exist, but the boy several years older. Once more a careful scrutiny of returns based upon several hundred children I have col-

There are many influences in modern life that make for psychic disintegration, and tend to reduce our individuality back to a polyzoic aggregate of cells and unshepherded states. For many, life is sessile and receptive, whereas unity is a product of actions. Mere knowing disaggregates if divorced from practical life. There is, too, such a multiplicity of cultures and theories. The views concerning the ego would not, perhaps, equal in number the 289 theories on the nature of the highest good reported by Varo, but their conflict alone makes it impossible to lead what Aristotle called the purely theoretic life of reason. Mixture of blood and heredity causes the ununified, if not contradictory, traits found in mongrel races. Imperfect health causes fluctuations of mood and those alterations of somatic feelings which not only lay the basis of parasitic personalities, but may of themselves alone cause mental perversion and even alienation. The weaker the body, the more it comes to the front and commands; the stronger it is, the more it obeys and the less it appears in consciousness. Over-culture, so common now for feeble souls, both distracts and weakens. Too many or too alien ideas forced upon an unwilling intelligence are not marriage of the soul to knowledge, but rape, the analogies of the results of which could be traced out at great length. This makes real love of knowledge impossible, but may cause a meretricious itch for dabbling with great subjects. The history of philosophy teaches such minds merely to hold no opinions. The rage for examination and explanation prevents real acquisition, which is automatic, and acts not unlike an emetic in interfering with mental digestion. Too many companions of

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lected, show no trace of Professor Baldwin's second stage of reduced fearlessness or bashfulness between two augmentations of it, but only a very steady reduction and change of base through all the early years of childhood.

Indeed, while believing the careful and prolonged studies of single children is one of the very best lines of work, and has given us some of our best data, I think that a mono- or duopaidic basis is not broad enough for *speculative interpretation* of such wide range. At least to estimate a work "drawn largely from direct observation of children," the value of which Professor Baldwin well says "consists in the possibility of their repeated corroboration," we should be told how many if not what children were studied, or at least what method was used to reach such general results. If, however, it is simply "the child" or the "concept of childhood" that here is analyzed, this method, too, has probably its place despite its peculiar dangers, but it is more that of the Baconian spider that evolves from within than of the ant that merely collects. Granting, however, both to have their place in the economy of nature, we hope both spider and ant may live to see the bee that both collects and evolves, enter the broad, new field of child study, which is now but a promising acreage of buds, and to taste her sweets.

the same, or of too many different sorts, city life, much society, and indeed civilization generally, is not favorable for the quiet, inner, Rousseau-like growth of country life near to nature. Too many toys, interests, studies, friends, dresses, pleasures, moods, and even too frequent resolutions of radical reform, are dissolutive.

On the other hand, an education that fits native interests, evokes will, has a natural instead of an artificial and programme-made unity; some occasional obstinacy and self-assertion, that contend for supremacy with other egos; the keeping of a personal conscience, a sense of duty and honor, and knowing how it feels to follow these against the mob; friends and interests, that the flavor of conviction be not utterly lost; some few, deep beliefs we could die for, even though the creed be not formulated; fixed and regular habits; vigorous thinking that has wondrous power to bring unity to the loosely cohering elements of our mental life; a life sphere that fits our ability and taste and that has not too many galling points of friction; a broadly based specialization that gives us a certain mastery in some small point, and is a refuge of the soul in which it finds compensation for many inferiorities; enough property to give an independent self-respect, but not enough to make us in any sense its slave; just pride of country, home, family, and having a character and reputation in the community that are what we deserve and have distinct and marked individual features about them; the bearing of responsibilities;—these cement and strengthen the ego synthesis.

A person is a vast aggregate of qualities and influences vinculated together, treated and acting as a unit. After Cicero many ancient and mediæval works on oratory listed the traits of an ideal socius, best calculated to influence men, and most worthy of respect, or most provocative of imitation. First was form, figure, complexion, and the factors of physical beauty, fine eyes, nose, chin, bust, foot, hand, shoulders, etc., the contour of anyone of which might have a perfection that was ravishing, and if truly put in marble would make a sculptor immortal. Physical beauty is an immense power, and ugliness is an eternal disadvantage. Next come dress and toilet, with every detail of hair, nails, shoes, head-gear, proper fashions, and even cosmetics, perfumery, etc., if and where needed, correct taste which is the beginning of art and which remedies defects of form, all of which are subjects worthy of long and detailed study as sources of proper personal influence. Third come the automatisms, which are among the most important media of likes and dislikes, and even fetichisms, tricks of articulation, of facial

expression, bearing and carriage, the use of the voice, positions and movements of hands and feet, smiling and laughing, habits of fan, handkerchief, napkin, knife and fork, gesture, inflection, all the minor morals of manners, the magnetic aura, atmosphere, presence, style, which reflect all one's environment, breeding and heredity, and which because they are unconscious reveal the true self that words, social forms and conventionalities so often hide. Then come the voluntary actions, either deeds accomplished or abilities which mark the range of the ego of will. What can one do? How would he act under the strain of jealousy, anger, love, fear, temptation, and in any possible condition? What is the vocational sphere of action? where would character give way? self-control be lost? and how much energy is there? Fifth, what are the quality and flux of the habitual currents of feeling? the temperament and dominant sentiments? Is there the hearty euphoria of that good fellowship which covers a multitude of sins? the good heart that is Prince Hal's "sun and moon"? Does duty rule? or is the soul weakened by self-indulgence? Is it malevolent? tricky? hypercritical? How will it stand the strain of disappointment or affection? of publicity? fame? fatigue? Is it stable or moody? harmonious or unbalanced? sickly? self-conscious and morbid? or hearty? eupeptic? or eucholic? Then, and far less prominent than we think, come the mental equipment or intellectual possessions of culture, the size of the fund of knowledge, the inventory of mental resources, and especially the breadth and height of sympathies, both for persons and ideas, the range of interests, the judgment and sense in the use of knowledge, originality, and independence of thought. If to these we add the still more adventitious advantages of fame, wealth, birth and name, we shall have a magazine of influences which has a power to hold other souls up together and to keep them occupied and well directed, the vast and manifold beneficence of which psychology is still unable to trace.

Such and other highest human qualities united in parent, teacher, friend, preacher, professor, doctor, hero, ideal or super man, who can let all his faculties go and yet be only and purely good, are far more unifying for the souls of those within their sphere of influence than institutions, social traditions, or mere impersonal and unembodied instruction. The Homeric world had no state, church, school; no Bible, literature, science, or inventions; but all was solvent in personalities, and in the natural relation between men. It, and not the mobs of degenerates, is the true expression of man's gregarious nature, and hence its marvelous fit to the estate of

youth which is moulded by contact with great characters, and, if it does not find needed heroes and leaders, makes them often of the poorest material, or finds tinsel idols in the cheapest fiction. These, with enough errors and sinners to exercise the instinct of "universal opposition," which in due season and degree is so essential an ingredient of character, constitute the fundamental features in the environment needed to develop well compacted personalities.

When we are told that nothing but the soul can mirror itself, that self-consciousness is the Bible of the psychologist, I reply that only a part of the soul is therein revealed; that personality has far deeper roots in unconsciousness; that the testimony of consciousness, wherein only a part of the soul content knows another part, can not express the most important elements; that all the processes in it are land-locked, as in an inland sea, far from the great ocean of life and mind, because thought must at best imitate sense, however dimly and remotely, and that consciousness is "not the creator or bearer of the ego-synthesis, but only one form of its expression." Even if we had a complete history of the consciousness of every member of the race, it would be a very incomplete expression of the human soul, not only because consciousness is yet in its babyhood, and the best things are not revealed in it yet, but because from its very nature they never can be. We have sought the real ego in the intellect. It is not there, nor yet in the will, which is a far better expression of it than thought. Its nucleus is below the threshold of consciousness. The mistake of ego-theorists is akin to that of those who thought icebergs were best studied from above the surface and were moved by winds, when in fact about nine-tenths of their mass is submerged, and they follow the deeper and more constant oceanic currents, often in the teeth of gales, vitiating all the old aerodynamic equations.

We must, therefore, without neglecting these older oracles, turn to a different source for real knowledge of the real self, viz.: the objective study of every phase and every growing stage of the psyche and of the soma in animals, savages, and children. Soul is vastly larger than consciousness, and the highest powers are those that spring from roots that start deepest down in the scale of life. Consciousness is as different from mind as froth is from beer, and the syllabub of some of its exploiters and "promotors" suggests the mediæval barber's apprenticeship, which ended when the tyro could make two tierces of foam from two ounces of soap. Perhaps the excuse of some philosophic apprentices, were it as naïve, would not be unlike that of the Boston tapster, who, when

remonstrated with by his customers for selling so little beer and so much froth, replied that the better the beer the more it foamed, and also that the profit was in the froth.

Hence child study, because of these limitations of introspection, and even of consciousness, and because the real deeper self can confessedly never be thus known, turns to more purely objective methods. It is a homely term, and psychogenesis, paidology, or some others might have been more academic, but it represents a movement so fundamental that it was necessary to appeal to the larger constituency of virgin minds, who knew none of the prejudices so inveterate in philosophic schools and sects, and to utilize the deep instinct of parental love which has created all education systems and institutions. In doing this education and philosophy have both gone back to re-examine the foundations from which they sprang; have turned to first principles and to plain common sense as the ultimate court of appeal, and sought to reaffirm the practical obligations of these studies and to meet some of the crying needs for a philosophy that shall do for our land and age what the great philosophers of other periods have done for theirs. Recha was rescued from a fire by a stranger in white who vanished, and her gratitude idealized her saviour till she thought she owed her life to an angel, and her mystic, contemplative mind elaborated a cult of worship which gradually absorbed her life almost to the point of mental alienation, when suddenly came the announcement that a man, A. B., who had snatched her from the flame, was dying for a woman's ministration. Her illusions vanished, and she found sanity, and he was restored by her to life, and a career of philanthropy. Philosophy was to Plato a quest of eternal foundations, when a decaying state and a sophistic culture seemed to threaten general dissolution. Later it wrought old cults to unity and opened the way for Christianity, and still later gave it an organ. It gave science its methods and instruments, unified the Teutonic spirit, and expressed the English induction and utilitarianism, and in this country it laid down the methods of church, state, school and college. Latterly, however, we have been almost playing with philosophy and fascinated by not only unfruitful but unsolvable problems, have striven to be critical and polemic, brilliant and literary, gone astray in technicalities and details, revived problems once vital, but now dead, because no longer practical in the high moral sense; rendered a rather doubtful and uncertain service to religion and plain right living, and above all hypostatized to theoretical regions the agencies that were meant to save men from passion, fill them with enthusiasm for the ideal, purge their souls from faction,

jealousy, superstition and selfishness, and bring consecration to the vocation of leading lives devoted to the highest service. With regard to the self, indeed we have lapsed almost to the standpoint of Condillac, who said: "When I smell a rose, *e. g.*, this sensation of smell is my entire ego." Teachers of philosophy, now called, like Recha, to more serviceable work, are responding as she did, and the results already seen are a new sense of the need of these chairs, despite the many rival claimants for scholastic time and money, the better ministration to troubled adolescent needs, the decline of epistemological and simply historical, and the increase of neurological and ethical teaching, the aid to impending religious and social transformation, and the better development of children and youth to the fullest maturity of mind and body. This is the best and highest test of home, school, church, state and civilization itself, and the basis of the only true philosophy, not only of education, but of history.[1]

[1]Although I have had help from many others in response to the questionnaires upon this topic, I desire to express my special indebtedness to the data collected by Miss Lillie A. Williams of Trenton, N. J., and Miss Sara E. Wiltse of Boston.

# PSYCHOLOGICAL LITERATURE.

(67) *Raumaesthetik und geometrisch-optische Täuschungen.* Von THEODOR LIPPS. Mit 183 Figuren und Einer Tafel. Schriften der Gesellschaft für psychologische Forschung: Heft 9 u. 10, 2te Sammlung. Leipzig: Verlag von J. A. Barth, 1897, pp. viii, 424.

*Die geometrisch-optischen Täuschungen.* Von WILHELM WUNDT. Des xxiv. Bandes der Abh. der math.-phys. Classe der kgl. sachs. Ges. der Wiss. no. 2. Mit 65 Textfiguren. Leipzig, B. G. Teubner, 1798, pp. 126.

In the *Beiträge zur Psychologie und Physiologie der Sinnesorgane*, the *Festschrift* prepared for Helmholtz' seventieth birthday (1891), Professor Lipps published a long paper (93 pages), entitled *Ästhetische Faktoren der Raumanschauung.* This paper should be studied before the reader ventures upon the book now before us; it gives an abstract and brief chronicle of the author's æsthetic theory, and of his view of the relation of the æsthetic problem to the problem of the geometrical optical illusions. Again, in the *Zeitschr. f. Psych. und Phys. der Sinnesorgane*, Bd. xii, Heft 1, is a preliminary communication upon the latter question, headed *Die geometrisch-optischen Täuschungen.* This should be read alongside of the book, as furnishing a conspectus of the author's treatment in the larger work.[1]

The fundamental idea of all these publications is that "the optical and the æsthetic impressions that a geometrical form makes upon us are merely two sides of one and the same thing, having their common root in ideas of mechanical activities." Every space formation, all formed space, is the seat or vehicle of living force; it strives or tends to rise or expand, it resists, yields, moves, runs out, etc., etc. In a word, it shows us the manner of its origin, the natural reason why it takes on just this form,—always, of course, after the analogy of our own human activity; and its æsthetic consideration is simply the translation of its presence or bare existence into this activity. As human action is directed upon some end, so is the activity in the space form: the principle of æsthetic freedom includes the free determination and the free realization of an end. Geometrical forms are ugly only (and always) when the force or life that is in them cannot work itself out, or is compelled to subserve the wrong end, to play an ill-fitting rôle. (Pp. 1-26.)

The 'naturalness' of a form, however, has its mechanical side. The 'free realization of an end' is at the same time mechanical uniformity, obedience to mechanical law. Not the mechanically regular form is beautiful, but the form which shows the free working out of a definite mechanical movement. Past experiences have given us a direct, not consciously mediated, 'feeling' for mechanical possibility; we 'feel' that in a particular figure the movement is assured, easy, effortless, while in another it is uncertain, unstable, forced. Putting this together with the result reached in the pre-

[1] A good discussion of the whole topic of geometrical-optical illusions will be found in ch. vii of Professor Sanford's "Laboratory Course."

ceding paragraph, we arrive at the principle of 'æsthetical-mechanical unity.' The column or the wave line is æsthetic: imagination reads human activity into it; it is mechanically right, the expression of mechanical uniformity; and it is, further, unity—the action of a personality, the working out of one mechanical force, given once and for all. (Pp. 26-41.)

The unity of 'becoming' or of self-production which the space form evinces, which in virtue of its æsthetical-mechanical interpretation in our feeling it must evince, may be of various kinds. We can distinguish successive from simultaneous unity, the unity of the column from the unity of the group or cluster of columns. The former we may call quantitative or singular unity; the latter, qualitative unity with quantitative differentiation. In the third place stands antagonistic or central unity, that of opposed activities arising from a common source. Prototype of (1) is the human volition directed upon a single point; prototype of (2), a human activity rooted in a single, qualitatively identical volition, but embracing a manifold as its object; prototype of (3), the volition that aims singly, with opposition of direction (stretching out the arms, *e. g.*). The relation of this theory to the doctrine of 'multiplicity in unity' is obvious. It only needs to be added that the unity of opposition implies the principle of equilibrium. (Pp. 42-50.)

The principle of equilibrium is wanted, however, in a wider sense. Every space form shows the balance of activity and counter-tendency. There would be no activity in a form at all, were not the form constantly threatened by, obliged to maintain itself against, the counter-activity. Nevertheless, in every concrete case, it is one of these activities that is, for our idea, the primary or 'real' activity of the form, while the antagonistic activity appears as a merely secondary tendency. The terms are, naturally, correlative. Thus, if we oppose the limiting activity of boundary lines to the expansive activity of the enclosed space, it is clear that limitation is the primary activity, expansion the secondary counter-tendency. Again, in the vertical figure which is conditioned (positively or negatively) by gravity, it is the activity of expansion or extension that is primary, the counter-activity or tendency that is secondary. And thirdly, in the case of direction of movement, the diverting activity is primary, the tendency to continuation in a straight line secondary. These three antagonisms are of prime importance for the theory of optical illusions, to which we now pass. (Pp. 50-60.)

These illusions arise as we ideate the forces of space forms, *i. e.*, let them work themselves out in our idea. We perceive a form; we have an idea of the activity producing it; this implies the idea of the working out of the activity; this idea is superimposed on the perception,—the activity works itself out; and the illusion is there. Note, then, that the illusion is not due to perception, but to deception of judgment; we compare perceptions under circumstances in which modifying ideas force themselves upon us, and the judgment of comparison is itself modified in the direction of these ideas. In other words: we superpose, in comparing, the modified memory-image of the one perception upon the other perception-image. The concomitant, modifying ideas are 'unconscious.' (Pp. 61-69, 203, 339, 368, viii, etc.) The reader will now understand how it is that the first sketch of Professor Lipps' theory appeared in the Helmholtz *Festschrift*.

Although the detailed exposition of the rest of the book adopts a classification by geometrical form, in place of that by the threefold antagonism of activity and counter-tendency mentioned above, the first section deals with the illusions of expansion and limitation

(pp. 70-140). We set out with the general rule, whose deduction is evident, that limited space magnitudes are as such underestimated. But the boundaries of a form may be 'mere' boundaries, or may themselves, *e. g.*, be 'forms.' So we get the rule of the 'concurrence' of interpretative ideas, and the distinction of 'grades' of limitation. If counter-boundaries differ in grade, illusions necessarily follow. Vertical extension is overestimated as compared with horizontal, since it is doubly extended: from below upwards by the force opposing gravity, from above downwards by gravity itself,—both primary activities. Exceptions must occur, under certain circumstances: when, *e. g.*, the concurrence of horizontal and vertical is replaced in idea by some other play of forces (circle), or when the vertical is subordinate in idea to the horizontal expansion (torus). Further: we may distinguish 'degree' of limitation from grade of limitation. Increase the bounding power of a boundary by making a figure smaller than it was, and you increase the grade of limitation, in arithmetical progression. But you do more: you increase the degree of limitation. For increase of limiting activity means increase of the counter-tendency, the expansion, or resistance to limitation; your boundary bounds, therefore, in higher degree, at a higher stage of limitation than it did before. And the reduction of the counter-tendency takes place in geometrical progression. Here, again, is occasion for illusion and modification of illusion. Besides, the question arises: when are we to regard the smaller figure as identical with the larger, *i. e.*, as the vehicle of an equal expansive tendency, and when are we to suppose that its initial expansive tendency was less? So we are led to the illusions of confluxion (linear) and contrast (superficial). Both depend upon identification, upon the adoption of the identity point of view (law of simultaneous unity).

The following section (pp. 141-256) discusses, with great minuteness, the illusions of division and composition. Here the reading becomes difficult. Indeed, the work as a whole is the reverse of easy. The reader should be warned never to pass over a back-reference, and never to attempt the book unless he has pen and ruler and compasses at his elbow. In ch. 29 of this section (varying magnitudes of the parts) he will do well to draw a rough system of curves, for guidance in future chapters. Very careful study is required, if justice is to be done to the author's reasoning.

We set out with primary conditions of illusion. Let us look at the whole: then the part, as part, has only that tendency to expansion which is peculiar to the whole in all its parts; the part is underestimated. Contrariwise, let us look at the part: then the part is not simply part, but also itself extension; the divided whole is overestimated. Over against these stand the secondary conditions. The part, as filling out the whole, as extending within it, should be overestimated; the divided whole, the space within which the parts bound each other independently, should be underestimated. The appeal is to experience; and experience defines the mutual relations of the conditions as follows: reference of the limits of the whole to the part means underestimation of the part; reference of the part to the limits of the whole means its overestimation. The greater the part in relation to the whole, the more is the part over, the whole underestimated; the smaller the part, the more is it under, the whole overestimated. True, this is merely a rough statement. The quality of the part, its qualitative relation to the whole in which it stands, affects the illusions. And in estimating the influence of the varying size of the parts we have to distinguish a quantitative factor in the apparent shortening of the whole (*i. e.*,

the quantum of tendency to expansion that is held in equilibrium by the limits of the part) from a 'gradual' factor (the grade of the limiting activity): their interplay gives three maxima and two minima of apparent length. Instances are the symmetrically trisected point distance, and the smaller circle placed concentrically within a larger. Quality again has its effect. But in making distinctions of quality within the parts of a whole we have traveled beyond the illusions of division proper; we can pass to those arising from the connection of distances (or lines) with surfaces. These lead us still further, by way of distances embraced between triangles, to the illusions set up by the coincidence of activities (1) whose directions are opposed, and (2) whose directions are relatively the same.

Here belongs the famous 'optical parodox,' the 'arrow-head and feather illusion,' the 'illusion of Müller-Lyer.' We may give Professor Lipps' account of it as an instance of his general treatment. Why do we overestimate the length of the horizontal line that lies between diverging end-pieces? The answer is this: "The terminal points of the line limit it, and limit also the oblique pieces. This second limiting activity works upwards and downwards, in so far as the oblique pieces trend upwards and downwards. It works outwards, in the horizonal direction, in so far as the oblique pieces trend outwards. Just in so far as this is the case must the limiting activity of the terminal points towards the inside, towards the horizontal line itself, be canceled by their limiting activity outwards, towards the oblique pieces. To the same degree, of course, the limiting activity of the points towards the oblique pieces is canceled by their activity on the side of the horizontal line. That is to say: the length of all these lines is overestimated." It follows that the illusion increases, within certain limits, with approximation of the oblique pieces to the horizontal; and that it decreases with increasing length of these pieces. Why, on the other hand, do we underestimate the length of the horizontal line that lies between converging end-pieces? "The limiting activity which the common terminal point exerts upon the horizontal line, and the limiting activities, relatively of the same direction, which it exerts upon the oblique pieces, reinforce one another." The illusion is less than in the former case, because the tension (produced as reaction by the increase of the limiting activity) is greater. The effect of the relative obliquity of the end-pieces is the same; that of their length naturally the precise opposite.

We come, in the third place, to the illusions of direction (pp. 257-320). They may arise under three conditions: when the differently directed forms or form elements are given contiguous; when change of direction occurs during the course of a single movement; when the different directions, though independent of one another, are spatially coincident. The vertical and (to a less degree) the horizontal directions are in every instance 'principal' directions. As the modifying activity is in all these cases the primary, there is a constant tendency to the overestimation of differences of direction, (The relation of this rule to the current theory of angular estimation is plain.) The principle that dominates the section is the principle of the 'mechanically unitary apprehension of directions'; and its rule runs: "If, in consequence of the conditions under which it takes place, a movement divides for our idea into various components, then in every case (or in every phase of the movement) that component is overestimated which in general (or in the particular phase) is most 'drawn upon,' or whose realization seems to be most energetically demanded, for the result be-

fore us." The rule evidently covers cases of apparent approximation as well as cases of apparent divergence of directions.

The final section (pp. 321-419) treats of variations of contour (superficial boundary). These take us back to the 'identification' question of the first section. Let the surfaces stand independently side by side; then we give them in idea an expansive tendency that fits their actual magnitude. Here come the illusions dependent on interaction of height and breadth. Let them now form parts of a single, differentiated whole: then we give them, despite their different size, one and the same expansive tendency. Here come the illusions of (rectangular) projection and retraction. From these we pass to those of reduction or tapering, taken first alone, then in connection with opposition of direction (where we are brought to the optical paradox again), and lastly in connection with axial activity. Reduction passes over, in its extreme form, to the point or gable. Finally, leaving right lines, the author discusses the effect of continuous curvature of the boundary, taking as his illustrations the scotia and the torus, the concave and the convex departure from the vertical.

In an epilogue Professor Lipps emphasizes the threefold result of his inquiry. He has, in principle, settled the question of optical illusion. Secondly,—and this is more important,—he has contributed to the establishment of an 'æsthetical mechanics,' to our æsthetical comprehension of the geometrical forms employed by the arts. And thirdly, he has illustrated the delicacy and uniformity of the psychological working of 'unconscious ideas.'

Of the æsthetic part of the work I have, in the above hasty sketch of its contents, said very little. In reality, there are æsthetic 'additions' at every pause in the march of the argument. As, however, the writer's whole æsthetic theory, the theory of 'mechanical anthropomorphism' or of 'anthropomorphic mechanics,' the harmony of the free activity of the human personality with the uniformities of mechanical forces, is given in the introduction,—and as the 'additions' merely carry out the general point of view in detail, showing where the optical illusion is a protest against the æsthetically (because mechanically) impossible, etc.,—it seems unnecessary to devote space to it here. Nevertheless, I believe that the æsthetic theory is, relatively, the strongest thing in the book, and, absolutely, a theory of the very highest scientific value.[1] Indeed, the æsthetic atmosphere is over all: the book at large, if we regard chs. 29-36 as an excursus (p. viii), is æsthetically planned and proportioned. Starting out from the Doric column, we find at the end of our reading that we have been taken through the Doric and Ionic orders, stylobate, column, entablature and pediment, step by step, illusion by illusion; torus and fillet and scotia of the base, fluting and entasis of the shaft, ovolo and abacus of the capital, architrave and frieze and cornice,—all have received their due meed of discussion and explanation. Moreover, the idea of linking the whole series of geometrical optical illusions to an all-embracing æsthetic theory is both novel and remarkable. The question is, whether it has been—whether it can be—carried out.

We must admit that Professor Lipps has been able to account for *all* the optical illusions that are familiar to us from the many recent essays upon the subject. We may admit, too,—at least, this is the impression that I have obtained from the book; I am not sure how far it is a true one—that his principle of explanation has a heuristic value. But serious objections present themselves to his point of

[1] The outline of a similar theory was roughly sketched by Vernon Lee and C. Anstruther-Thompson in the *Contemporary Review*, Oct. and Nov., 1897.

view. (1) Can we travel, without more ado, from the real, tridimensional, undoubtedly 'purposive' structure, column or tree or tower, to the superficial or linear figure, the bare line or circle or square? We easily and consciously read our own activity into the former; I have hardly ever found myself doing so into the latter. I can, with some effort, 'feel' the solidity of the black disc on a white background, and the hollowness, emptiness, of the white on black; I can also read movement into the Müller-Lyer lines; and I can sympathize with the smooth or unsmooth flow of the line in the corrected or uncorrected segmental and stilted arch. But in the first of these cases I call to aid a tri-dimensional secondary idea, and in the second and third I seem myself to move with or along the lines, rather than to let them move or carry movement. I should, therefore, incline to doubt Professor Lipps' statement that solidity presents 'in principle' nothing new as compared with superficial extension (*Zeits., loc. cit.*, p. 41), and his conclusion that our apprehension of the plane geometrical figure follows on directly from that of the tri-dimensional structure. (2) But the reply is obvious: the 'reading in' of activity in cases of illusion is 'unconscious,' stereotyped in us by habit; so far from its being necessary for us to realize our personifications, it would be curious if we did so (*Zeits., loc. cit.*, pp. 43, 44). To which I offer the counter-reply: If I am not now tempted in any way by the forms themselves to read my activity into them, why should my ancestors have done this, and done it so much as a matter of course and habit that their attitude has laid permanent constraint upon me? What was so highly conscious once, surely might be at least weakly conscious now, more especially now that I am trying to make it conscious. Professor Lipps has written a 'logic' or 'mathematics' (p. 170) of optical illusion, and his method has led him to rectify certain too general statements of former theories (pp. 220, 147, 271); but unless one is prepared to accept the Herbartian unconscious, with all its implications, one can hardly grant that the theory is psychological. Apart from such school dogma, I can see no reason whatsoever (Professor Lipps complains in his *Festschrift* paper that utterances upon this point are vague) against regarding the great bulk of optical illusions as matters of perception, and not of judgment. (3) A third objection, which I am less confident in urging, is this: Does not the apparent heuristic value of the writer's theory lie in the fact that it is able to adapt itself *ex post facto* to all and every illusion? Professor Lipps asserts or admits (p. 287) that it is a tautology: the primary activity produces the illusion,—but then the 'primary' activity is just that activity which does produce the illusion. There is no arguing with a theory which would find the facts equally intelligibie if they were given upside-down; and I cannot help thinking that the present theory would hold its own very well in an inverted world.

Of the general importance of the work there can be no doubt. It is a model of patient constructive argumentation. Psychologists would owe a still greater debt of gratitude to the author if he should now publish a detailed critique of rival theories: there is no one of them, he says (p. 421), which, if taken seriously, does not break down under the weight of factual exceptions. This is a hard saying, and must be tested. In conclusion, I would advise the reader to make an index of figures as he proceeds; the lack of indices means much loss of time.

Professor Wundt's monograph has appeared so lately that any review at the present time must show signs of imperfect assimila-

tion. Nevertheless, it stands in such marked contrast to Professor Lipps' book that some notice must be taken of it in this connection. The work was suggested by, or grew out of, the recent investigation by Thiéry (*Phil. Stud.*, XII, p. 125). The treatment is historical; Oppel's figures are constantly referred to. Here, at once, is a great difference between the two inquiries.

Wundt begins by laying down methodological rules. Complex figures, showing many illusion-motives, must be split up into simpler; figures whose illusion may be due to coincident motives must be varied in such a way as to exclude one motive after another; great weight is to be attached to reversible illusions, since in them the only change of conditions lies in the perceiving subject. As heuristic maxim we have the rule that physiological conditions must be regarded as primary, other things equal, psychological as secondary. (Pp. 1-6. *Cf.* Lipps, p. vii.)

The investigation sets out from the reversible illusions of perspective (pp. 6-30). By variation of conditions and test of other proposed explanations, the conclusion is reached that "the physiological conditions [of these illusions] consist in the *fixation* of the objects by the eye and the *movement* of the point of regard along definite contours." The irreversible illusions fall, first, into those of extension and of direction. Illusions of each class may be variable (changing in magnitude and perhaps even in quality with change of conditions) or constant. The former are accompanied by irreversible illusions of perspective; the latter either have no such concomitants, or have them under quite different conditions.

We pass, then, to the variable illusions of extension (pp. 30-53). Here belong the illusions of filled and open linear extensions, of the vertically and horizontally fluted square, the optical paradox, Láska's illusion (apparently varying length of line with varying size of inclosed angle), etc. It is shown that the illusion of perspective is secondary, that of size primary. Helmholtz' contrast theory, Müller-Lyer's confluxion, Heymans' movement contrast (*cf. Phil. Stud.*, xviii., pp. 613 ff.) are weighed and found wanting. The illusions are due to the motives to movement of the line of regard which reside in the nature of the objects as given.

Under the constant illusions of extension (pp. 53-61) fall the overestimation of verticals as compared with horizontals, the overestimation of the upper half of a vertical, and the (monocular) overestimation of the outward horizontal. The perspective theory is here out of court: we must fall back upon dioptrical or muscular asymmetry. By elimination, we are left with the latter as the sole explanation. The absence of the illusions in the circle is an indirect confirmation of this standpoint.

The variable illusions of direction (pp. 51-78) bring us to the question of the estimation of angles, to Hering's and Zöllner's patterns. Perspective comes to its rights again, as secondary motive. It is most interesting to compare Wundt's account of the illusion and lack of illusion in the series of superposed horizontal arcs (overestimation of the acute tangential angles and arousal of perspective) with Lipps' discussion on pp. 314 ff. There seems to be no doubt that Wundt's explanation of his Fig. 40 (*cf.* his analysis of Figs. 59 and 60) explains also Lipps' Fig. 155; but the reader must judge for himself. Wundt accounts for the overestimation of small angles by an extension of Delbœuf's idea: "where mechanical movements of short duration are produced," he says, "but movements which differ in duration in the individual case while their other conditions remain the same, there is consumption of a relatively greater amount of energy in the shorter movement, since it

requires greater energy to start a definite movement than it does to keep a present movement going." Movements of regard, then, are the condition of the illusions.

The constant illusion of upward divergence of parallel verticals is referred, also, to the eye muscles (J. Müller); Helmholtz' attempt at a retinal-image theory is not successful here any more than it was for the preceding illusions. Recklinghausen's illusion in indirect vision is explained by the change in retinal image caused by projection in space as determined by eye movement. (Pp. 78-85.)

So far we have had illusions due to physiological motives. There are others (pp. 85-93) that are due to the direct arousal of the psychological process of association, and that may therefore be termed 'illusions of association.' The illusion here, as in the former instances—Wundt is explicit upon the point—is a matter of sense-perception, not of judgment; but its direct origination is psychological, not physiological. We may distinguish illusions of approximation and illusions of contrast. Typical of the former is the line unevenly divided into three parts, which seems to be evenly trisected; typical of the latter, the Ebbinghaus circle-figures (Lipps, p. 222).

Finally, we reach illusions that result from a complexity of motives (pp. 93-105). These may be wholly physiological (mixture of variable and constant), as in the torus and scotia illusion, the illusions in the triangle, Poggendorff's illusion, Loeb's illusion; or partly physiological and partly associative, as in the interrupted circle of Müller-Lyer, superposed segments, Oppel's double and single circles, etc.

These, then, are the facts. There follows a critique of theories (pp. 105-116). We have the psychological 'mother-theory,' of deception of judgment by imagination. Out of this have come the perspective theory of Hering, Guye, Thiéry; the contrast theory of Helmholtz, Heymans, Loeb (somewhat better is the contrast-confluxion theory of Müller-Lyer); and the mechanical-æsthetical theory of Lipps,—known to Wundt only from the *Festschrift* and *Zeitsch.* papers, etc., not from the book. The author criticises this theory from very much the same point of view as that which I have adopted above, but urges some further objections to it. Just by reason of its æsthetic unity, he says, it cannot take account of the empirical interplay of motives; it neglects the reversible perspective illusions, the secondary perspective ideas, the influence of movements of the line of regard, etc. Wundt's own theory (pp. 116-126) seeks the motives to illusion in the process of perception itself. On the extreme physiological side we have the 'constant' illusions of the text; then come the 'reversible' and 'variable' illusions motived by retinal-image (fixation) and eye-movement, with their psychological correlate of the 'assimilation' of ideational elements; while on the psychological side stand the 'association' illusions, the result of the interrelation or the reciprocal influence of simultaneous perceptions. The retinal image needs no discussion. And we know that extensive eye movements give rise to sensations; we must, therefore, assume that less extensive movements do so too, only that they are 'fused,' so to speak, in the idea of 'change of position,' just as slight touches are referred to the objects that affect the skin. If the illusion persists for the resting eye, that is because the points of the figure not now fixated nevertheless stimulate the eye to movement, and the 'stimulation' works as actual traversing of the space, actual eye movement, would work.

Professor Lipps' by-the-way remarks concerning eye-movement (p. 310) are, I think, more than met by Wundt's polemic against the

'unconscious inferences' and general logical tendencies of popular psychology. Wundt has shown conclusively that a great many illusions can be explained as visual assimilations, whose physiological conditions are fixation and movement of regard. On the other hand, while I do not doubt that many other illusions are really 'associative,' due to the conscious arousal of associated visual ideas, I cannot find the concepts of 'approximation' and 'contrast' entirely satisfactory. Color contrast, which Wundt instances in connection with them, is, surely, a different thing altogether; it is, as Hering and his pupils have sufficiently shown, a matter of sensation, of physiological changes at the periphery. The 'law of relativity' is too vague to account for the details of illusion.[1] Perhaps it may be possible, by continued investigation, to find a working physiological hypothesis for the outlying group of facts. In any case, the incompleteness of Wundt's account seems preferable, in the present state of psychological knowledge, to the over-adequacy or 'tautology' of Lipps' theory.[2] E. B. T.

(68) *Geschichte der neueren deutschen Psychologie.* MAX DESSOIR. 2ª Auflage, 1er Halbband, pp. 356. Carl Duncker, Berlin, 1897.

One volume only of Dr. Dessoir's history has appeared (1894). We now have this volume, or a part of it, in second edition. Criticism of the earlier output confessed to the author's great diligence in covering an immense mass of literature, for the most part now dead, but pointed out serious defects in matter and in arrangement. The new edition, "eine völlig neue Bearbeitung des Gegenstands," calls for careful scrutiny and evaluation.

The plan of the work shows major changes in matter and form. A new introduction on ancient, mediæval and recent psychology, and a bibliography are affixed. The author's profession of an invariable use of primary sources in the modern period is a timely defense against the charge of inaccuracy. Lengthy citations are avoided and there is an evident effort to shun prolixity. Fuller treatment of the psychology of the last century has crowded out the more constructive part of the first edition, the part of most doubtful value. For the revision of this we must wait.

In Part I, named "Die Begruendung der deutschen Psychologie," are sections on Leibniz, Thomasius, Wolff, his followers and opponents, and eclectics. The systems of Leibniz and Wolff have been reconsidered and their essentials presented in much more comprehensive form, while Rüdiger and Crusius, two chief opponents of Wolff, are allowed freer utterance. Nearly double the space has been allotted this division. Part II occupies two-thirds of the volume and gives the development of the "Erfahrungsseelenlehre" in Germany from 1750 to 1800. The corresponding part of the first

[1] To be concrete. Suppose that it could be shown that the estimation of the central circles in Ebbinghaus' figures is explicable (say in terms of energy of movement; *cf.* Wundt's explanation as regards acute and obtuse angles) as an absolute illusion: that the one circle is overestimated, the other underestimated, whether the two figures are given together or not. The contrast illusion would, of course, follow: but it would not be due to the juxtaposition of the two figures, the interrelation of perceptions, but rather to the pre-existence of physiological (assimilative) motives to illusion in each figure. The psychological 'contrast' would thus be reduced to perceptual processes with an intelligible physical substrate. In the meantime, Loeb's assertion of a space-contrast and attribution of space-values to the retinal elements ('space' being on a par with 'color,' *e. g.*) must remain wholly unconvincing to psychologists, Herbartian or other (see *Zeitsch.*, xvi, p. 298).

[2] Some of Wundt's statements as to motives to illusion appear, in the light of Lipps' work, to be too sweeping: see the critique of Lipps' theory above. But the necessary modifications can easily be made, without prejudice to the general standpoint.

edition brought the history down to 1780, but was again much more fragmentary than this. Revision and improvement are everywhere prominent. Much more space is devoted to historical summary, and classification is less forced than before. 'Scholastic,' 'natural science,' 'popular' and 'analytic,' are clearly more significant psychological rubrics for the period than 'materialistic' and 'anti-materialistic.' The new arrangement permits tardy justice in many cases, as, *e. g.*, Lossius and Irwing, who are rightly termed physiological instead of materialistic psychologists. Foreign influences are taken more carefully into account, though the evident importance of the English empiricists to the eighteenth century psychology of experience is not made prominent. Especially Locke, to whose distinction of inner and outer perception the "Erfahrungsseelenlehre" owes so much, deserves more attention. Only a half page of generalization is given.

It would be quite useless to profess in this connection a detailed criticism of the summary and evaluation which Dr. Dessoir has undertaken at large, but, failing in this, a somewhat close scrutiny of a bit chosen from the whole and focused with care may do justice to the workmanship of the entire piece. Take, for instance, the work of L. H. Jakob, one of the more important of the lesser men. The system gains in importance by being a titled "Erfahrungsseelenlehre" from the end of the century, the psychology whose development consumes a large part of the book. D.'s discussion of the work under the heading "Assoziationspsychologie" does it doubtful justice, while it obscures its value as a treatise on empirical or experience psychology. And D.'s caveat against confusing this trend with English associationism scarcely justifies the disposition. The "Methodologische Richtung" and the "Vorliebe für begriffliche Zergliederungen," which writers of this class show, seem rather to relate them to the analysts. D. makes Tetens' "Philosophische Versuche" (1777) the culmination of the empirical trend of the last century. Jakob's system, written fourteen years later, marks an advance in "Erfahrungsseelenlehre." While it professes to be psychology of the inner sense, it gives an important place to physiology (*e. g.*, 4th ed., pp. 6 and 215), and inserts in the "Physiology of the Human Mind" a discussion of the phenomena of the outer sense in parallel with a discussion of the inner. Empirical psychology has evidently come to mean more than a "pure psychology of internal perception which * * * * completely disregarded the physical conditions of mental phenomena" (Külpe, Introd. to Phil., trans., p. 61). J.'s prime distinction of inner and outer sense is neglected by D. The inner sense is reviewed in two sentences which throw no light on its significance. The first half of the book is better summarized than the last. The more complex faculties are slighted, the method of classification of desires is given incompletely, and the relation of desire to instinct and passion is omitted. Finally, there is no reference made to the contents of the second part of the work on the "Pathology of the Human Mind." On the other hand all of the citations from Jakob are verified, and, in the main, are well chosen. If one may judge the detail of the whole by this fraction, one would be inclined to say that the factual reproduction is correct and of unequivocal value. This is of especial importance to Americans, to whom much of Dr. Dessoir's source-material is not available. I will only add that practically all of the minor errors of the first edition, brought out by detailed criticism, stand corrected in the new volume.

I. MADISON BENTLEY.

(69) *Magic, Stage Illusions and Scientific Diversions, including Trick Photography.* ALBERT A. HOPKINS, N. Y 1897, pp. 56.

The claim of the preface that "this work occupies a unique field in the extensive literature of magic," is well founded. No book has ever before appeared that dealt with these matters in so full and clear a manner. A few books claiming to give *exposés* of stage tricks etc., have been published, but usually they, like the tricksters themselves, have only divulged the secrets of a few worn-out illusions, and have left the great mass still a mystery, and the reader in doubt whether the more startling feats are not, after all, the effects of "occult" powers or "spirits." In this case, however, the author has given us a clear and scientific explanation of all kinds of legerdemain and stage illusions as they appear to the spectator and as they exist behind the scenes.

It is useless to attempt, in a brief review, to give any adequate idea of what the book contains, so full is it of interesting matter.

The introduction by H. R. Evans gives a brief history of magic from earliest times. The five sections of the book are devoted to (I) Conjurors' Tricks and Stage Illusions, (II) Ancient Magic, (III) Science in the Theatre, (IV) Automata and Curious Toys, (V) Photographic Diversions (including trick photography and spirit photography). Nearly every explanation is accompanied by one or more illustrations, so that every detail is made perfectly intelligible.

One is unable to decide which is to be admired more, the absurd simplicity or the elaborate preparation upon which the different tricks depend for their success. Such tricks as the "animated mouse" or "slate writing" illustrate the former, while "disappearances" of many and diverse forms, as well as sudden reappearances, depend upon the latter plan. A good illustration, however, of elaborate preparation is seen in "second sight" or mind reading. For the performance of this feat an elaborate system of signs is used, requiring, one would say, *months* to learn and make perfect by practice. But when once it is perfected, a little skillful questioning which creates no suspicion on the part of the audience, is all that is necessary to give the operator all she needs to know — all that she gives back to them as the result of her "remarkable" powers.

Presumably all theatre-goers know that many realistic effects are produced by elaborate machinery. But it may be doubted if very many of even constant attenders are aware *how* elaborate, and least of all by what means, the different effects are produced. All this is explained in the section devoted to it.

In fire-eating, sword-swallowing and sword-walking, we pass from trickery pure and simple to the realm of marvels accomplished by pure skill on the part of the operator. The sword is actually swallowed and its point reaches to the bottom of the stomach. We are here told how it is done.

Space will not permit of further mention of marvelous and interesting things herein contained. The work is valuable and timely. The psychologist will find here, ready prepared, many illustrations of psychic principles. To one studying the psychology of occultism the facts here given will prove very valuable. Teacher and parent alike will find it useful, since one can hardly imagine anything more calculated to stimulate a boy's imagination and ingenuity than such a mine of marvelous feats that he can learn to perform, interesting toys that he can make, which are at once instructive, fascinating and innocent. The facts set forth constitute a forcible proof that our organs of sense are not infallible, and secondly, it is evident —

a fact that has been too little appreciated in all discussion of such matters — that no expense of time or money is spared, or scientific principle neglected, in order to produce something that shall pass for marvelous.

A bibliography of 160 authors will be appreciated by psychologists and all others who may wish to investigate the subject. G.

(70) *Les éléments du caractère et leurs lois de combinaison.* By PAULIN MALAPERT. Alcan, Paris, 1897, pp. 302.

Every one interested in the subject of Mr. Malapert will find this book very profitable reading. The author is not very original, a fact which he himself acknowledges again and again; and he does not claim that he proposes a classification which is worthy of being called new. But he offers a very conscientious study; he knows his subject thoroughly, and, it seems to me, that he is especially successful in his mild criticism of authors who have dealt with this subject before.

First of all Mr. Malapert denies the necessity of considering the physiological aspect of the question as the basis of the whole problem. He proves clearly that even the authors who advanced physiological causes were finally forced to admit that they, after all, really used psychical arguments in their studies and especially in the classification of characters. Pages 7-9, he gives a very good criticism of Mr. Fouillée's theory of temperament, founded on biological causes. Pages 14-15, he gives his own point of view.

Where have we to study character? Mr. Malapert admits that the nucleus of character is individual, and is innate with us. The external conditions, milieu, climate, etc., may only modify, but do not create this primitive nucleus. (He tries to show here that H. Taine, who has often used a very sharp language indeed, has been generally misunderstood.) It would seem, then, that the place where the very essence of the character is to be studied is with the child. But, says Mr. Malapert, there character has not yet had occasion to manifest itself. On the contrary, only with the adult we may study character in its whole development: at the age of twenty or twenty-five, but not earlier, man has had occasion to show all the different aspects of his character.

*First Part.* In order to avoid the one-sided theories on character found with his predecessors, Mr. Malapert, before offering a classification of character as a whole, proposes four classifications, one for each element constituting the character as a whole. Classification according to sensitiveness, to intelligence, to automatic will, and to voluntary (that is, conscious) will. All of these classifications rest on a single principle, that of *more* and *less*. I can not enter into any details here; there are a great many sub-divisions for each of these large classes.

*Second Part.* This part gives us the laws of the combination of the elements of the character, the different degrees of sensitiveness of intelligence, and so on. Like the rest of the book this part also is worked out very carefully. But there is no strict order in the arrangement of the matter. This is not meant as a reproach, for, if such order existed, it would presuppose a single principle to direct us. But as Mr. Malapert himself recognizes, we have not yet advanced so far in the study of character as to arrive at unity. The fourth chapter shows this very clearly. After a short exposition of the most valuable classifications of character made within the last few years, and an excellent criticism of the most important failures in each, the author offers, as being the best within the present reach, a combination of the theories of MM. Fouillée and

Ribot. (Apathiques—Affectifs—Intellectuels—Actifs—Tempérés—Volontaires.) As will be readily seen, the author does not assume the responsibility of giving the preference in classification either to sensitiveness, or to intelligence, or to will. Consequently he presents a mixture void of all unity. Perhaps, when we shall have arrived at a better and more thorough knowledge of the essence of these three faculties, we shall be able to decide. As far as one can judge now, it seems to me that intelligence should be considered the leading faculty. The fact alone, that, except when one has phenomena entirely automatic to deal with, the intellectual element is never wanting, while the elements of sensitiveness and of will are very often completely absent, would constitute a strong argument in favor of intelligence.

*Third Part.* In the fifty last pages of the book, we have the theories of formation and development of character which we have just studied in its broadest and most many-sided manifestations. I only mention the fact that in the problem of the influence of will, Mr. Malapert finally takes his place among the Neo-Criticists, and especially he shares the view of Mr. Renouvier. This does not seem to me to be a very valuable feature of the book. The "*formula*" the author arrives at in his conclusion: "It is the duty of every one to have a character" (Le devoir pour chacun, c'est d'avoir du caractère), is in fact nothing but words. However, the book loses none of its value on account of this; it is the best means of becoming acquainted with the present state of researches in this very important chapter of psychology. A. SCHINZ, PH. D.

(71) *Essai sur l'obligation morale.* By GEORGE FULLIQUET. Alcan, Paris, 1898, pp. 450.

Mr. Fulliquet is an author who became celebrated some years ago by his book, "La pensée religieuse dans le Nouveau Testament." I can but regret that he has abandoned the field of theological studies as well as the field of historical researches, for in both kinds of work he is a man who can do much towards the advancement of science. His "Essai sur l'obligation morale" is a new assertion (exactly as the book of the Abbé Piat, which will also be reviewed in this number of the JOURNAL) of ancient philosophy in opposition to recent theories to-day prevalent in Ethics. Mr. Fulliquet has many qualities in common with old philosophers; among others prolixity (his essay consists of no less than 450 large sized pages) and a great talent for repeating well-known ideas, and even ideas he himself has already developed in other parts of his book. I admit that the author has a great talent of exposition and a very good style. I admit, also, that his way of argumentation is in general on a higher level than that of the Catholic author I spoke of. I admit especially that his intentions are excellent; but I do not admit that such philosophical publications are of any value. It is beautiful; it is elegant; it is sincere; it is generous—in a word it shows the spirit of the metaphysical publications in France, but it is not scientific. Besides, in spite of all his efforts, the author does not do justice to the philosophy of to-day. If he himself recognizes that the theory of "Libertas Indifferentiæ," with the so-called Ass of Buridan, was proposed before Aristoteles, and if, on the other hand, the scientists are not willing to accept it, there must certainly be some very good reason for it. And if even they should decidedly be wrong, then the partisans of liberty must have other arguments to offer than such as have been proposed over and over again, and which have proved unable to compel silence among determinists. Every one knows that the partisans of liberty affirm

that determinism does not account for all phenomena in our life, and consequently it is unnecessary to have a very long discussion upon all those arguments familiar to philosophers; why insist so haughtily upon the influence of the idea of liberty, conscience of liberty, duty? etc. Even the step from moral obligation to the idea of God (which is here, I must say, clearer and brighter formulated than anywhere else, as far as I know) is not new to anybody. And still the same as for a possibility of liberty on account of the free choice between two determined possibilites, this theory exposed not only by Prof. James, whom the author quotes, but by quite a number of philosophers centuries ago.

Another point is that Mr. Fulliquet has no right to say that any philosopher has ever refused to admit the existence of moral obligation; some only refused to admit that the origin of this obligation has to be looked for in a transcendental world, or simply outside of the world, and of the chain of causes and effects—that is quite different.

Finally: Mr. Fulliquet distinguishes two kinds of obligations: (1) the moral obligation, and (2) the obligations by egotism, by intelligence, by association, by the ideal, and so forth,—and he concludes therefrom: the obligations of the second kind being not liable to be conceived in the same way as moral obligation, they are not really obligations at all. Now, would it not be possible, and for reasons just as good, if not better, to say: If moral obligation in the sense of Mr. Fulliquet is not liable to be conceived like the other obligations *for which we have a rational explanation*, it is not really an obligation in the sense we can give to this word in the ordinary--the rational—way of speaking.

As for the substitution of an "unconscious ego" as the creator of free acts, in the place of an "intelligible ego" with Kant, it seems to me rather a difference of words than of notion.

It is of no special interest to speak here of the history of ethics, that is, the exposition of some systems of ethics in this century (Kant, Schopenhaur, Mr. Renouvier, H. Spencer, Ch. Secrétan, Mr. Fouillée, Guyau). This part of the book also offers nothing new: there have been very able publications of this kind before the one by Mr. Fulliquet.

I wish to say, in closing, that most of the above criticism applies not only to Mr. Fulliquet's book, but to all those—so numerous today—which take up well-known problems in an antiquated way.

A. SCHINZ, PH. D.

(72) *Essai sur les conditions et les limites de la certitude logique.* By G. MILHAUD. 2e édition revue. Alcan, Paris, 1898.

The author belongs to the class of thinkers who are gradually taking the place of the French "Spiritualistes" followers of Cousin. Their most important representative is Mr. Boutroux. The book, "De la certitude logique," belongs to the same category as "De la contingence des lois de la nature," by Boutroux, and the "Essai sur les données immédiates de la conscience," by Bergson. All of them agree with modern science and its methods; even the neo-Kantian school of Renonvier does not satisfy their wants of exactitude. On the other hand, however, they try to escape from the results of the new science, and they elaborate their theories on the basis of the science of Logic.

The most evident principle of science is the principle of contradiction; and it is this very first principle, the consequence of which Mr. Milhaud attacks sharply, as soon as these consequences are applied outside a certain field of speculation. He distinguishes

between the *objective* knowledge, which is given to us, and the *subjective* knowledge, which is *constructed by us*. Science is based entirely upon subjective knowledge: *we* accept definitions, and on this ground we build up science; but all our definitions are conventional, relative. We admit them as a result based upon a certain amount of facts, but we never know whether there are no other facts which perhaps might not correspond to the definition; and as we never know whether we have cognizance of all possible facts connected with an absolute definition, the result is that "no lurid mind will ever have the right to declare a hypothesis as definitive" ("Jamais un esprit éclairé n'aura le droit de déclarer une hypothèse définitive.) He attacks the positivist method on its own ground. He takes advantage of the concessions of Stuart Mill, in his "Philosophy of Hamilton," but pushes the theory to the very end. Not only must Mill be able to recognize that something entirely black may at the same time be white, and that a round object may perhaps be square, and that 2x2 are possibly 5, but in order to remain consistent, Mill has no right to hesitate in admitting that *A* may at the same time be *non A*.—Consequently, and that is the object of the whole demonstration, we can never condemn any theory on account of its relation with some other theory. Since we are the authors ourselves of our science, we have constructed it with elements invented by ourselves; and it may be perfectly possible that our science is wrong.

Mr. M. verifies his theory on mathematics, and applies it to moral liberty, the non-Euclidian geometry, and the solution of the antimonies of Kant by Mr. Renouvier.

I do not agree with the author in the conclusions he arrives at. If the theoretical scepticism he asserts has to be applied also in practical life—and it is the very reason for the theory, to save in that way moral liberty—I hardly see how science would be of any use to us. And yet if we may judge according to the past of science, there is no reason to doubt the practical value of the experimental and positive methods—no matter what the psychological origin of the method may be. However, it is a very interesting book, and one may derive great benefit in reading it.

A. SCHINZ, PH. D.

(73) *L'individualité et l'erreur individualiste.* FÉLIX LE DANTEC. Alcan, Paris, 1898, pp. 175.

Within a few months this is the third book published by this author. It is not very surprising, therefore, that he takes up the largely the same topics not only in every book, but in the different chapters of each volume. We cannot expect from a scientist that he should collect each month matter enough to fill a new book..... Mr. Le Dantec is a fighter, and since his physiologico-deterministic ideas were attacked sharply, he thinks it necessary to defend himself again. It seems to me that there was no reason for being surprised when, for instance, Catholic reviewers of his earlier books expressed views different from his own. Mr. Le Dantec is like so many writers of to-day who fail to recognize that the public consists of two classes of people: the scholars and the readers untrained in philosophy. I am sure that among the first class nobody would desagree with Mr. Le Dantec in his deterministic views; and if some do, it is only for reasons of sentiment, as the author says himself; they do not introduce the liberty, that is, the belief in an interruption of the strictly necessary sequence of causes and effects, within their scientific deductions. Whatever their conviction may be as to the existence of moral liberty, their

*method* of researches in physiology remains the same—and that is the important point.

However,one thing astonishes me,and that is that Mr. Le Dantec, in looking for names to give to the representatives of the two methods of investigation, he adopts that of *psychologists* for all those who refuse a sound scientific method. It would seem to me that, even if some ten or twenty years ago one had any right to classify in this manner in France,to-day it is entirely out of place in the country of Ribot,Pierre Janet,Binet,and other prominent psychologists, as well as in any other.

"Individualism" which he wishes to remove is hardly worth dwelling upon, since its manifest inanity has been recognized by every one. Not only does the *milieu* change from one moment to another,modifying our way of thinking, feeling and willing, but the individual himself who thinks, feels and wills is liable to change; physiological modifications of his being take place with him and influence his mode of psychical reaction; man is not like a stone which ever remains the same.

Let me point out an interesting discussion and successful refutation of the Archesthetism of the late E. D. Cope of Philadelphia.

I need not to call attention to the lucid article on Physiological Senescence which appeared in the *Revue Philosophique* last year. Senescence is due to the outweighing of the muscular substance by the conjunctive or skeletal substance of the muscle.

A. SCHINZ, PH. D.

(74) *Comment naissent les mythes.* PAUL REGNAUD. Alcan, Paris, 1898, 249 pages.

The sharp contest on the problem of the origin of myths continues. Our author takes his position midway between the philologists of the school of Max Müller, and, more recently, of Oldenberg in Germany, on the one hand, and on the other the psychologists, as Gaidoz in France and especially A. Lang, in England. Mr. Regnaud develops more fully the point of view of Bergaigne, which he had already accepted in his former publications.

The origin of the Indo-European mythology is found in the Vedahs. Simple figures of speech (metaphors) in Vedic hymns were converted into realities or personifications. For instance, *agni*, the soul, before its development is accorded a very small place in the heart of man; it is considered as short as a thumb, thence the name of *poucet*, the little thumb. All the different features of the story, not only the name and the persons, but its very elements are explained in such way. In the Vedic hymns there is no story yet; the imagination only brought together the elements in them, and finally composed the myth of the little thumb.

The same explanation holds good in the case of the Deluge. The idea of such an event has its origin in the substitution of the legend which we all know, to a figurative description of the elements of sacrifice, when the religious act is about to take place or is actually performed.—And the same for other myths.

Any one who would hear such an explanation for the first time will find it hard to accept. However, after having conscientiously read the book of Mr. Regnaud to the end, it seems evident that there is a truth in this theory. But, on the other hand, the author seems to me unjust in his attitude towards the new school, and particularly towards its head, A. Lang. If in the myth here offered for consideration we might possibly agree with Mr. Regnaud, it does not result therefrom that that would be the case everywhere else. The psychological thesis, that the same myths found in dif-

ferent places were formed independently one from the other, according to the uniformity of the thought of man in the different parts of the globe, seems to me just as well applicable to many mythological stories. It is not necessary to presume that all myths have sprung up in exactly the same way. Different theories may be alternatively correct.

A. SCHINZ, PH. D.

(75) *Problèmes d'esthétique et de morale.* C. R. C. HERCKENRATH. Alcan, 1898, 163 pages.

*a. Æsthetics.* The author tries to arrive at a theory of beauty by way of psychogenesis. The beautiful, he says, consists, with children and savage people, in a simple and ingenuous combination of the elements of the beautiful object, especially color and sound. Gradually the simple becomes tiresome and we look for other and more complicated combinations of colors and sounds. The artist who, during his whole life, is dealing with such matters, acquires a very fine taste which ordinary people do not arrive at. Taste changes, and although not discutable in individuals is capable of progress at any time. "Good taste—that is, the conclusion—is a taste more refined, more cultivated than bad taste" (p. 46).—It is the first time, so far as I know, that intellectual theories have been applied so thoroughly to æsthetics, and I cannot but think that this way of treating the problem of beauty is full of promise. The chapters on the Sublime, on the Problem of the Tragic, and on the Comic Art and Laughing, do not offer the same originality and freshness of thought as the one on the Sense of Beauty, although the intellectual element is also not lacking here.

*b. Ethics.* The chapters grouped under this head, "Le Problème Moral," show a still greater lack of originality. The author evidently has never studied very thoroughly any history of ethics, for if he had, he would have remarked that all his theories are very old. He seems to believe, for instance, that he has found out (by correcting and completing Schopenhauer) that *sympathy* is the irreductible element of morality, while every one knows how often this principle has been advanced as the basis of ethics, and that even often the very word has been used, *e. g.*, Adam Smith. Besides, the intellectual element is not so thoroughly carried through in the second part of the book as it was in the first.

A. SCHINZ, PH. D.

(76) *La personne humaine.* L'ABBÉ C. PIAT. Alcan, Paris, 1897, 401 pages.

All views and opinions are represented in the excellent collection, "Bibliothèque de Philosophie Contemporaine," of Mr. Alcan. The author of this book is a dignitary of the Roman Catholic Church, who takes up the old idea of human personality and of the soul, and tries to maintain its efficiency on contrast to modern phenomenism. His argumentation takes up 400 pages, but without advancing a single argument that has not been presented a thousand of times before.

I doubt very much whether arguments which were not able to check the progress of modern psychology when advanced for the thousandth time would have this result after the thousandth and first time.

Further, even if one would be perfectly willing to admit that definitive solutions of the problems of the soul or mind have not yet been given, that would certainly not necessarily imply, as MR. C.

Piat seems to think, that the new phenomenistic theories have to be considered as entirely wrong.

I will give in a few words the ideas as represented by the Abbot:

I Part. The *Perception*, which man has common with animals, gives us already the feeling of the continuity of the "Ego." And this consciousness is so strong that it cannot be given up: science will never prevail against the inner experience.

II Part. The *Reflection* belongs to man alone. The theory of transformism claims that reflection is only a prolongation of organic process. But, says the author—whose answer here is not so definite as in the first part of the book—the theory the transformism arrives at, cannot yet be considered more than an hypothesis.

III Part. The *Sense of Responsibility* is the final and decisive argument against phenomenism. Liberty is conceivable, since conscious causes are different in quality from the unconscious or physical causes. Duty imposes itself and consequently the old theories concerning the human conscious personality gives a more-satisfactory explanation of the reality than the modern theories.

A. SCHINZ, PH. D.

(77) *Einige Experimente über Gesichtsbilder in Traum.* By PROF. J. MOURLY VOLD. Dritter Internationale Congress für Psychologie. Munich, 1897, pp. 355–357.

The experiments on dreams, reported to the Psychological Congress at Munich by Professor J. Mourly Vold of Christiania, suggested to the writer a study of the visual element in the dreams of his students in the State Normal School at Westfield, Massachusetts. Each member of a small class in senior psychology was provided with a set of the following objects—eleven in all—cut from colored paper: a square (green), 1½x1½ in., and an octagon (light violet), cut from a square, 1½ x 1½ in.; a square (red), 2 x 2 in.; and the following objects cut from squares, 2 x 2 in.; a heart (violet), a robin (green), a coffee-cup (light yellow), a Maltese cross (blue), a circle (pink), a triangle (blue), a hen (light green), and a cat (light blue).

The conditions imposed were similar to those mentioned by Professor Vold: The objects were to be spread out on a white background, intensely observed from two to ten minutes just before retiring, and the light extinguished without looking at the flame. The experiments were to be made on ten successive nights, and the details of the remembered dreams written out the mornings following. Fourteen women—ranging in years from twenty to thirty—fulfilled the conditions of the test and reported 221 dreams. The largest number of dreams reported by any one member of the class, for the whole period of ten nights, was thirty-five, and the smallest number seven.

Color was a pronounced feature of forty-seven of the dreams. Red was reported seventeen times; green, six times; blue, white, yellow, and black each five times; violet, three times; and gray once. In eighteen of the dreams, the color element was attributed directly to the colored papers observed, and the forms of the colored papers—as the hen and cat—accounted for eleven more of the dreams.

A strong visual element was reported in 133 of the dreams, a marked auditory element in ten, and a pronounced motor element —riding, running, or falling—in twenty-three of the dreams. Fifty-seven of the dreams refer to family and friends; thirty-three to present vocation; twelve to sickness, death, or accidents; ten to personal appearance—chiefly dress; fifteen to animals and six to plants.

The emotional state in twenty-one of the dreams is reported distinctly painful; twelve as pleasant, and four as perplexing. Three dreamed that they were being chased—one by a cat, one by a man, and one by a peacock. The cat, the dreamer thought, might have been suggested by the observation of the one cut from colored paper, and the student who dreamed of being chased by a peacock suggested that possibly the hen and the combination of colors might have laid the foundation for this dream.

But seventy-nine of the dreams were localized in the recent past —within a fortnight—and sixty-three were localized in the remote past—more than a year before. Several reported that although they dreamed of incidents associated with their early childhood, their apparent age was never lessened. One hundred and fifty-six, or about 70 per cent. of the dreams, were satisfactorily accounted for as having some connection with the thoughts and experiences of the preceding day or week.

WILL S. MONROE.

(78) *The Evolution of the Idea of God.* By GRANT ALLEN. Henry Holt & Co., New York, 1897, pp. 447.

This is a very convenient résumé of the work of Herbert Spencer on "Ecclesiastical Institutions," Fraser's "Golden Bough," Mannhardt's "Baum Cultus," Robertson Smith, Tylor, Speth, Hartland, Barring-Gould and other writers known to folklorists in this field. A more fit title would have been: "Beliefs and Rites of Ancient People who dwelt about the Mediterranean as the Source of Christianity." The author has collected material for twenty and been writing the book for ten years, and states that every question of the objective validity of any belief is foreign from his purpose, tells us that he is not such a "gross and crass Euhemerist as to insist dogmatically on the historical existence of a personal Jesus," does "not pretend in any one instance to have proven my point," but only to have made made out a *prima facie* case for a grand jury, etc. His "case" is, after digesting the arguments of Frazer and Mannhardt, the indebtedness to the latter of whom he and Frazer scantily recognize, that among the gods deliberately made by killing priest-kings and their substitutes, corn and wine gods were especially prominent, that Jesus, whether or not He ever really existed, is simply another corn and wine god manufactured by killing. His talk was of vines and branches, eating his body and drinking his blood, a sower, workers in a vineyard, mustard seeds, leaven, harvest, bread of life, water made wine, and a legend made his complexion the color of wheat and his hair of wine. Many other details indicate the same conclusion. While these elements may be present, we think this author unduly magnifies their importance, and that his method is uncritical, and in strong and unfavorable contrast to that of most of the authors whose ideas he here compiles. He follows Spencer's ghost theory of the origin of gods, and wrests facts of other authors who hold the opposite view of animism to support his theory.

(79) *A History of Dancing from the Earliest Ages to our Own Time.* From the French of GASTON VUILLIER. D. Appleton & Co., New York, 1898.

This luxurious quarto has twenty full-page plates and 409 illustrations, and is supplemented by a sketch of dancing in England by Joseph Grego, and combines scholarly and popular qualities into a happy result. The reader can form a pretty clear idea of what the

pavane, bolero, cachucha, prado, rigadoon, gavotte, polka, maiade, farandole, bayadère, branle, strathespey, ranelagh, alfresco, mabille, and many other dances once immensely in vogue, but now nearly forgotten, really were. In some lands every province has its own peculiar dances; semi-savage dances mimic the characteristic actions of almost the fauna of the country. Every human vocation is represented; every emotion expressed; every form of asceticism, ecstasy, and worship have their dances, so do every typical stage, epoch, event and act of life, and every low passion.

(80) *The Non-Religion of the Future.* By M. GUYAU. Henry Holt & Co., New York, 1897, pp. 543.

The basis of religion is in man's social nature. It is universal socio-morphism. A man is religious only if and when he superposes another society more powerful, cultured, universal, and cosmic upon his own. Theology is an attempt to explain theology by analogies drawn from human society. Religion is destined to vanish, like Comte's theological stage of thought. Metaphysical, philosophical and scientific ideas will take its place. Children should not be taught religion, so that there may be no need of convulsive reconstruction later. In one chapter we are told how a new husband, whose wife is virgin in soul, should at once but wisely begin her religious enfranchisement before she limit his own mental freedom by exerting the opposite influence. Religion is collective life, not human only, but cosmic. Immortality may be sought by good works, and personal post-mortem continuance is regarded stoically as a bare possibility.

(81) *Memory and its Cultivation.* By F. W. ELDRIDGE GREEN, M. D., F. R. C. S. K. Paul, Trench, Trübner & Co., London, 1897, pp. 311.

This book is in the International Scientific Series, but is unusually disappointing. There is no reference to literature, or, I think, to any of the experimental studies of the subject in recent years. The brain chart, which is the frontispiece, suggests nothing whatever of the work of the last score or so of years, and phrenology, with thirty-nine faculties and stories from Abercrombie, and fifty-one pages and twenty-two rules on cultivation of memory, conclude the work. All sensory impressions, we are told, are permanently stored in the thalami; but at present we do not know where the faculties are located. In the absence of almost everything popular on the subject, it is possible that there may be somewhere those who can derive good from such a work.

(82) *A Course in Experimental Psychology.* By EDMUND C. SANFORD, PH. D., Assistant Professor of Psychology, Clark University. Boston, 1897, pp. 449.

This volume marks the completion of Part I on sensation and perception. As was to be expected, the larger part of the book is taken up with the eye and vision, the other senses being treated in 89 pages. It is copiously illustrated, well printed and indexed, and, so far as the writer knows, unique in its field in any language. The first half was published two years ago, and has been extensively used, and its completion will be welcomed.

(83) *Studies from the Yale Psychological Laboratory.* Edited by EDWARD W. SCRIPTURE, PH. D. Vol. IV, pp. 141.

This, fourth of the series, contains seven articles, the longest being an "elementary course in psychological measurements" by the

editor. The four studies together, published since Oct. 1, 1893, show a high degree of productivity at the Yale Laboratory, which few in the country can surpass, and indicate a remarkably good equipment considering the relatively limited means at the disposal of the department, and, in connection with the two other volumes published during the time, great industry.

(84) *Psychologie des Sectes.* Par SCIPIO SIGHELE. Paris, 1898, pp. 231.

This interesting and important book, here translated into French by L. Brandin, is by the author of "La Foule Criminelle," and is an even more important work. The author is more critical and detailed than Le Bon, whom he excoriates, and presents an interesting and comprehensive review of collective psychology, past and future; a classification of crowds; treats at length the differences between sects and parties; the power of leaders; their uniformity and tactics, and their dominant instinct of revolt. The morality of sects is then discussed; their want of equilibrium and permanence; their criminal propensities, and the work closes with an arraignment of parliamentarianism.

(85) *La Timidité.* Par L. DUGAS. Félix Alcan, Paris, 1898, pp. 167.

Social timidity, or excessive bashfulness, is due to lack of sympathy with others, to awkwardness or stupidity, or extreme susceptibility. It is not entirely a physical emotion, and is associated with aboulia. It may be spontaneous or reflex, and this distinction constitutes its two types. Intellectual timidity is fully treated. It is neither a vice nor a virtue, but may come to have high moral virtue if rightly treated.

(86) *Évolution Individuelle et Hérédité.* Par FÉLIX LE DANTEC. Paris, 1898, pp. 308.

In this theory of quantitative variation scissipare monoplastids are first described in their modes of assimilation, adaptation and correlation, and then monoplastids with their evolution. The second part treats polyplastids, then individual development, and their modes of co-ordination and their laws of heredity. The third part is devoted to discussions of embryonic acceleration, the inheritance of acquired character and telegony, or the influence of the first male.

(87) *Wild Traits in Tame Animals.* By LOUIS ROBINSON, M. D. Blackwood, 1897, pp. 329.

These familiar talks are intended as an introduction to evolution, to show plain people with a taste for natural history, illustrations of Darwinism right about them. The animals selected are the dog, horse, donkey, cattle, sheep, goat, pig, cat and poultry. There is much allusion to traits called social and even political. The volume is of much interest to psychologists.

(88) *Theoretical Ethics.* By MILTON VALENTINE, D. D., LL. D., Professor of Theology in the Lutheran Seminary at Gettysburg, Pa. Chicago, 1897, pp. 232.

This is the outcome of many years of teaching and lecturing, and treats the fact of moral distinctions, their faculty or essence, and the nature, supremacy, moral agency, and reality of right and

wrong, ethical views under ethical teaching, and the ethical task under Christianity.

(89) *Dynamic Idealism.* By ALFRED H. LLOYD, PH. D. Chicago, 1898, pp. 298.

This is an elementary course in the metaphysics of psychology, and was given in lectures at the University of Michigan. The first duty of psychology is to give a distinct, explicit doctrine of the soul. Psychology without metaphysics is useless. Part I considers the world of things, part and whole, change, organism of the body, outer world, and language. Part II treats ideas in form of historical illustration, ideas—not forms—but forces, illustrations from education, body, mind, soul, time; dynamic vs. formal idealism, consciousness as intellect. Part III treats the world of acts, reaction and will.

(90) *A Compendium of Insanity.* By JOHN B. CHAPIN, M. D., LL. D. Philadelphia, 1898, pp. 234.

The author is physician-in-chief of the Pennsylvania Hospital for the Insane, and his book contains a concise statement of the clinical aspect of the various abnormal mental states, with directions for treatment and management, together with a few illustrations. It is unique in being brief, and will on that account be welcomed by physicians and students, and it will prove useful for members of the legal profession interested in forensic medicine.

(91) *La Fatigue Intellectuelle.* Par A. BINET et V. HENRI. Paris, 1898, pp. 338.

This is a comprehensive treatment of mental fatigue with 90 figures, and will be reviewed at length later.

# NOTES AND NEWS.

## Rational Fear of Thunder and Lightning.

The suggestive *questionnaire*, Study of Fears, in a late number of this review (Vol. VIII, No. 2), points out "the fact that this fear leads all the others, and as that yet so small a fraction of one per cent. of deaths are by lightning, show that, as yet, our correspondents have not adjusted their scale of fear to that of danger. Perhaps nowhere is the power of noise to control feeling and to excite imagery so well seen" (p. 203). Is it not, then, most remarkable that the most prominent of all fears is the most baseless? And how shall evolutionary psychology reconcile this fact with its prime assumption that mental functions originated in and are developed through utility? Even if it be granted that mentality often develops, especially in earlier life, against utility, it is hard to see how such a prominent yet useless and harmful fear escaped being eliminated by natural selection. The biologist who would find a correspondingly prominent bodily function and organ would unhesitatingly pronounce that it must have grown up in the struggle for existence, or what is implied therein. Does it not seem unlikely that mentality in such a form as fear of thunder and lightning is a mere morbid phenomenon, a mere perversion, especially when we note that civilization and complete maturity do not erase it? Indeed, among savages, as Lumholtz noted among the Australians, the electric discharges merely excite to joyous dancing and gesticulation, just as is often noted in children. Further, many beasts, as particularly the *felidæ*, the puma, lion, etc., are joyfully excited by thunder-storms, whereas the civilized dog is apt to slink under the bed. The bang and glare are gratefully stimulating to crude sensation, and as the direful effects of lightning are so rare in inexperience, it is difficult to understand how the great fear of thunder and lightning arose and developed under natural evolution. We know how quickly wild animals adjust themselves to the roar of the railway train and glare of the headlight; and it would seem that thunder and lightning is an analogous case, that the phenomena, as such, would come to be taken as a matter of course, and particularly by the more highly developed. That the fact is directly opposite to this biological deduction, certainly suggests an interesting problem. And, as has been implied in our remaks hitherto, menace, or shock to eye or ear, is far from accounting for this phenomenon.

As perhaps throwing some light on this subject I will relate an experience of my own. One afternoon last summer when the sky was slightly overcast, but neither thunder nor lighting apparent, I was walking on the street, when I was suddenly arrested by a peculiar sensation, as if some subtle atmospheric influence was swaying through me. As this increased, a strange and obscure fear took possession of me, and for some moments I was rooted to the spot, and deeply oppressed by a peculiar dread. The experience lasted, in all, for perhaps a minute, and during the time I was perfectly self-possessed, and my aroused scientific curiosity was closely observant of the situation and emotion and searching for the cause. I

knew at once that it was not a mere subjective phenomenon, but the objective source was entirely unexplained till I afterward learned that at the exact moment of my singular experience a most violent magnetic storm had swept over the country. That this pulsated through me, bringing a great oppression and fear, is the only explanation I can give. And I remarked that the oppression and fear were not merely at the sensation, but were mainly involved in it; that is, the nervous disturbance was directly correlated with the depression and fear. Now, my electrical sensitiveness is very great, and I remember on one occasion to have felt electrical disturbance from a small storm passing to one side at the distance of more than a mile from me, and to which I was perfectly regardless at the moment; and I am disposed to believe that the uncontrollable irrational fear which often possesses me during thunder-storms is largely and directly based on nervous disturbance produced by the violent electrical changes. This idea is strengthened when I remember having gone through an extremely bad thunder-storm with almost no fear merely because I had taken refuge in a large church, where, I take it, the mass of dry air acted as an insulator. While I knew churches were quite liable to be struck by lightning, yet I was little disturbed. The suggestion that I have then to make is this, that certain types of highly organized nervous systems are very responsive to electrical changes, these producing directly great mental disturbance involving fear. I conceive that another type of nervous organization might only have felt exhilaration and joy in the case of the magnetic storm I first mentioned, another might have been angry, another have been quite unresponsive. The changing phases of electrical tension in the air, not only in case of storm, but the ever changing electrification, daily and seasonal, undoubtedly stimulates nerve activities in varying ways according to temperament and idiosyncrasy. A highly nervous gentleman, whom I told that for myself railway travel shook me up pleasantly, replied that for himself it shook him down unpleasantly; which illustrates how oppositely the same stimulus may work — upon one for exhilaration, upon another for depression. On the whole, then, I believe that fear of thunder and lightning is, in some wise, a necessary incident of a certain nervous organization, and has its immediate explanation by physiology rather than psychology.

As further investigation of the subject I would suggest that a *questionnaire* on the experience of persons in the rare magnetic storms might be useful in pointing out matter for research. The experience I had last summer was entirely unique for me, but like experiences may be common. Again, direct experiment in changing the form and tension of atmospheric electricity might easily be made upon persons, who, however, should be taken unawares and unexpecting. For instance, the nervous invalid mentioned on p. 201 of the recent article on Fear in this review, might, unknown to herself, be variously insulated during storms, and the nervous and mental effects noted. I urge particularly that the person who is experimented on should be kept in entire ignorance of any experiment, for nothing vitiates and complicates psychological experiment more than expectancy, often complex by the agent. As a practical matter I may mention that I find that during a thunder-storm a slow pacing back and forth, breathing very deeply and slowly, will greatly relieve nervous and mental agitation, and I think that a subterranean chamber would give perfect relief.

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In the February number of the *Atlantic Monthly* Professor Münsterberg publishes a sharp criticism of Dr. Scripture's recent book, "The New Psychology." Dr. Scripture is an extremist upon the quantitative side in experimental psychology. The whole of mental life must be brought, whether it will or no, under the physical categories of time, space and energy. And if the psychological facts are at all discomposed by the arrangement, finding themselves in strange company and not knowing where to look for their friends, why, so much the worse for the facts; they must get used to it. Professor Münsterberg is equally extreme upon the qualitative side; you cannot now, he says, and you never will measure a mental process. The reference to physical categories depends upon a quibble; you go to a book for the time-relations of consciousness, and what you find discussed is the consciousness of time-relations, and so on.

It is not profitable to interfere in discussions of this sort. They are incidental to the present status of the science of experimental psychology, and the two combatants in the case before us are fully able to take care of themselves. Dr. Scripture may, if he will, fall back upon Professor Cattell's paper on "Mental Measurement," published in the *Philosophical Review* some five years ago; and Professor Münsterberg may feel his position strengthened by what Dr. Wolff has recently said in the *Zeitschrift* about the psychological experiment. *Magna est veritas et*—ultimately—*prævalebit*. There is, however, one point which the *Atlantic Monthly* article includes in the issue, but which seems to be really separate from it, that may be treated as a matter for itself, without intrusion into the controversy: the question of what experimental psychology may be expected to do for the teacher. Professor Münsterberg thinks that it will, as it can, do nothing. We cannot share this opinion, for the following reasons.

Every mental process may be looked at in two ways, as existence or as function. Whether we can measure sensations, regarded as existences, has long been debated in experimental psychology; and the outcome of the debate is still to be expected. Of course a pressure sensation called forth by a 2-lb. weight is not analyzable into two pressure sensations of 1 lb. each; and the visual perception of a blood orange is not a fusion of the visual perceptions of three tangerines. The question is only whether such considerations are the alpha and omega of existential measurement. But while we may, for certain psychological ends, find it convenient to look at mental processes as existences, we *must* look at them as functions; and this, whether we are 'parallelists' or 'interactionists.' In the former case we have at least to say that the brains which now throw off these and these processes, as the correlate of their physiological functioning, are the brains that have survived in the struggle for existence; mental processes are thus at least indicative of organic function. In the latter we can find no reason for the existence of mental processes, save that they have themselves proved serviceable for organic survival in the course of evolution. The conception of mind as function is thus forced upon us. But function can be measured. If I can just see a black dot on a white ground at a distance of one foot, while my friend still just sees it at a distance of three, then his brightness sensitivity is three times as great as mine. If I remember two-thirds of a mass of visual material, presented under standard conditions, and my friend remembers five-sixteenths, then our visual memories stand to each other in fidelity of reproduction as

32 to 15. If, using all my partial memories, I can recall five arguments of a given total, while my friend remembers eight, then the practical value of his memory is one and three-fifths as great as that of mine. All these cases are cases of measurement; but all are cases of the measurement of mental processes regarded as functions of the organism, not as mere existences. And it is here, in our belief, that the psychological laboratory begins without any question to be of service to the teacher. There is no doubt that we can measure mental function. The instances above given are crude and insufficiently qualified; but their principle is sound. We can measure span and fidelity of memory, quickness and accuracy of apprehension, range and direction of imagination, capacity of sustained attention; we can measure inventiveness, adaptiveness, observing power, cool-headedness, suggestibility, etc., etc. Measurements of all these functions may not have yet been made; they may not be the special functions which are of the chiefest interest just now to experimental psychologists. But such measurements can be made; and, when made, are of primary importance to the teacher. E. B. T.

Professor Sternberg calls attention in the *Centralblatt für Physiologie* to an earlier article ("Zur Physiologie und Pathologie des Lesens") by Dr. Goldscheider and R. F. Müller, *Zeitschrift für klinische Medicine*, Vol. XXIII, p. 131, that I had not cited in a paper on "Apperception," published in this JOURNAL last April. The *Zeitschrift* was not taken at Cornell, and, although I had seen the title in the bibliographies, made only a half-hearted attempt to obtain it, as neither the subject nor the place of publication indicated that it had a direct bearing upon my problem. The incident is a warning not to overlook anything that promises to have even an indirect connection with the question in hand, provided that question be psychological.

Goldscheider and Müller's investigation grew out of the controversy in the literature of aphasia, as to whether reading was by letters or by word form. His experiments began by determining the number of simple lines that could be seen with an exposure of .01 sec. and traced the increasing number as the elements were arranged in patterns, were formed into letters, and the letters were united into words, and the words into familiar sentences. The influence of meaning was studied by omitting or changing certain letters and noting the way in which the word was completed. In brief, the results showed that reading was both by letters and by word form; that certain letters were of more importance than others, and that memory images and association play an important part in perception. My experiments agree with his in every point.

W. B. PILLSBURY.

## THE SIMPLE REACTION.

The following passage from the third edition of Wundt's *Vorlesungen* (p. 316, *n.*) is of interest in the light of recent discussions of the simple reaction:

"In some [recent] investigations upon reaction-times, the expressions 'sensorial' and 'muscular reaction' have evidently been employed in a sense entirely different from that in which I use them here. In certain cases directions have been given to the sub-

ject which differ in essential points from those that condition the complete and shortened forms of reaction; in others, the choice of the reaction form has been left to his own judgment. This must be the reason that some observers have been unable to find any difference at all between the sensorial and the muscular reaction, while others have recorded differences in the results obtained from different subjects — the sensorial reaction proving to be longer than the muscular, or the muscular longer than the sensorial, or the two of equal length, according to the individual under investigation. At all events, the terms 'sensorial' and 'muscular' reaction have been taken here in a different meaning from that assigned them in the text [p. 316]; and it is further probable that the subjects themselves have varied in their understanding of the directions given. No general statement can be made, however, as to the interpretation of experiments of this kind; the printed accounts of them are too defective. Nothing is said, in particular, of any observance of the criteria of the complete and shortened forms laid down just now [pp. 313 ff.], of attention to the erroneous reactions, the premature reactions, the distracting effect of outside stimuli, etc. Indeed, there are some papers which do not tell us even of the mean variation of the separate observations. Now it is quite possible that there exist forms of reaction over and above the complete or 'sensorial' and the shortened or 'muscular' forms, and that some of these may possess psychological interest [*cf.* p. 313]. But it seems to me that we have as yet no experiments that we can employ for a settlement of this question. Nor do I think that the observations which we have can sustain the conclusion that different individuals show 'typical' differences, which determine the duration and character of their reactions. For it is not improbable that the results which these differences are made to account for are due partly to differences in interpretation of the directions given to the subjects, and partly to habits of experiment, accidentally established and psychologically irrelevant."

### Portraits.

I have recently had large, almost life-size platinotypes of Wundt and Fechner made for the Cornell Laboratory by Herr Carl Bellach, Gellertstrasse, Leipzig. As the pictures are very good and not expensive, it seems not worth while to call attention to them here. The portrait of Wundt costs mk. 40, that of Fechner, mk. 60. The total expense of the pictures, delivered at the laboratory, was mk.107 and $1.50. E. B. T.

The first general meeting of the Childhood Society of Great Britain, founded in 1896, was held in London, Jan. 12, Sir Douglas Galton, the chairman of the society, presiding.

The Open Court Publishing Co., Chicago, Ill., offer a series of thirty-four portraits of psychologists, suitable for framing, at the very moderate price of $5.00 (better paper $7.00). Among the psychologists upon their list are Cabanis, Maine de Biran, Beneke, G. E. Müller, E. H. Weber, Fechner, Helmholtz, Hering, Aubert, Mach, Stumpf, Wernicke, Exner, Munk, Steinthal, Brentano, Paul Janet, Ribot, Taine, Fouillée, Binet, Bain, Romanes, Ll. Morgan, Bastian, James, Ward, Sully, Stanley Hall, Ladd, Wundt. It may be hoped that Herbart and Lotze will be added.

Dr. W. H. R. Rivers, lecturer in experimental psychology at the University of Cambridge and at University College, London, will accompany the Cambridge expedition to Torres Straits and Borneo. In conjunction with Drs. W. McDougall and C. I. Myers, Dr. Rivers will "test the senses and sensibility of the natives, as far as it will be possible under local conditions, and make whatever observations he can on the mental processes of the natives. Besides the ordinary instruments for anthropometry there will be a small, carefully selected collection of apparatus for experimental psychology. Two mechanical phonographs will be taken to record the native songs, music and languages." Opportunity will thus be given for "studying comparative experimental psychology in the field." The expedition starts at the beginning of March, and returns in the early summer of 1899.

The 1898 meeting of the American Psychological Association will be held in New York. Professor H. Münsterberg is president, and Dr. L. Farrand secretary for the current year.

## Books Received.

Arréat, Lucien. Les croyances de demain. F. Alcan, Paris, 1898, pp. 178. Price, frs. 2.50.

Bertrand, Alexis. L'Enseignement intégral. F. Alcan, Paris, 1898, pp. 313. Price, frs. 5.

Chapin, John B. A Compendium of Insanity. (Illustrated.) W. B. Saunders, Philadelphia, 1898, pp. 234. Price, $1.25.

Binet, A., et Henri, V. La fatigue intellectuelle. Avec 90 figures et 3 planches hors texte. Schleicher Frères, Editeurs, Paris, 1898, pp. 338.

Le Dantec, F. Evolution individuelle et hérédité. Theorie de la variation quantitative. F. Alcan, Paris, 1898, pp. 308. Price, frs. 6.

Dugas, L. La timidité. Etude psychologique et morale. F. Alcan, Paris, 1898, pp. 167. Price, frs. 2.50.

Istituto Psichiatrico di Reggio-Enidia. Lavori originali del laboritorio di psicologia sperimentale (1896-97). Tipografia di Stefano Calderini e Figlio, Reggio-Enidia, 1897. Anno I, Volume I, pp. irregular.

Janet, Pierre. Néuroses et idées fixes. 1er vol. Etudes expérimentales sur les troubles de la volonté, de l'attention, de la mémoire, sur les émotions, les idées obsédantes et leur traitement (travaux du laboratoire de psychologie de la clinique à la Salpétrière. Première série). F. Alcan, Paris, 1898, pp. 492. Price, frs. 12.

Lipps, Th. Raumaesthetik und geometrisch-optische Taeuschungen. J. A. Barth, 1897. Price, mk. 12.00.

Pick, Leopold. Die vierte Dimension. Arwed Strauch, Leipzig, 1898, pp. 46. Mk. 1.00.

Scripture, E. W. (Editor.) Studies from the Yale Psychological Laboratory. Vol. IV, 1896, pp. 141. Yale Psy. Lab., New Haven, Conn. Price, $1.

Sidis, Boris. The Psychology of Suggestion. A research into the subconscious nature of man and society. With an introduction by Professor William James of Harvard University. D. Appleton & Co., N. Y., 1898, pp. 386. Price, $1.75.

Titchener, Edward Bradford. A Primer of Psychology. The Macmillan Co., N. Y., 1898, pp. 314. Price, $1.50.

WRESCHNER, ARTHUR. Methodologische Beiträge zu Psychophysischen Messungen (auf experimenteller grundlage). Schriften der Gesells f. Psychologische Forschung, Heft 2. (iii sammlung.) Johann Ambrosius Barth, Leipzig, 1898, pp. 238. Price, mk. 7.

WUNDT, WILHELM. Die Geometrisch-Optischen Täuschungen. Des XXIV Bandes der Abhandlun gen der math.-phys. Classe der Königl. Sachs-Gosells der Wiss. No. II. Mit 65 Textfiguren. B. G. Teubner, Leipzig, 1898, pp. 178. Price, mk. 5.